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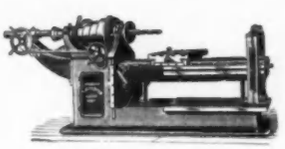

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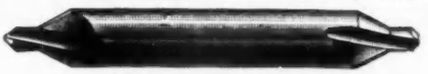

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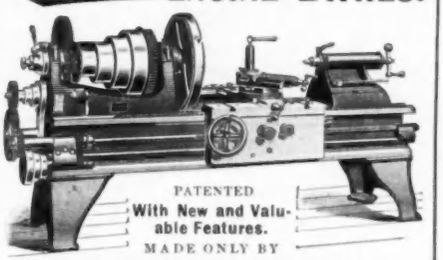

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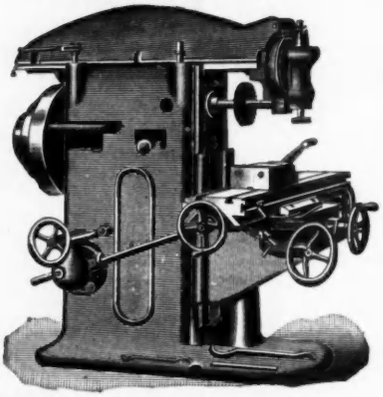

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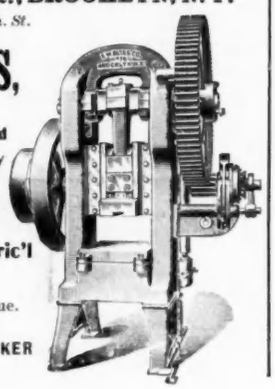

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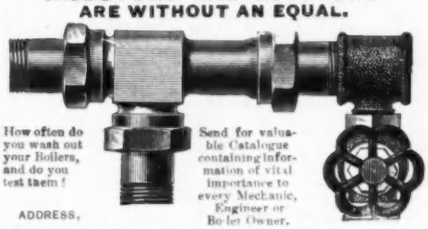

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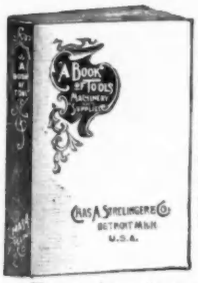

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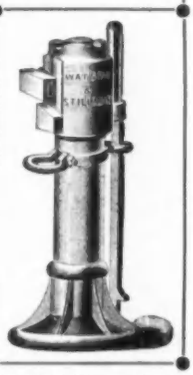

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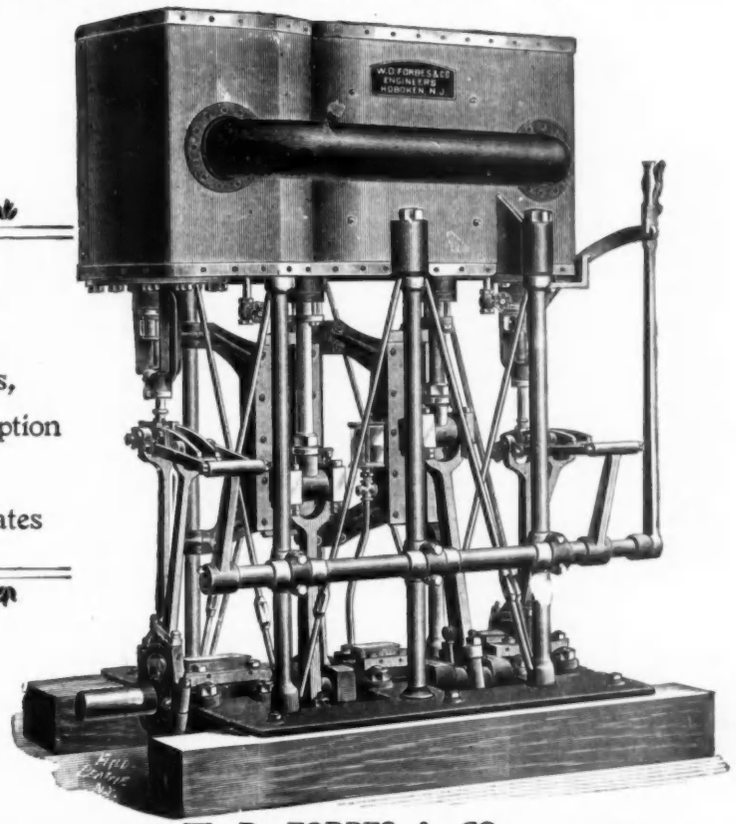

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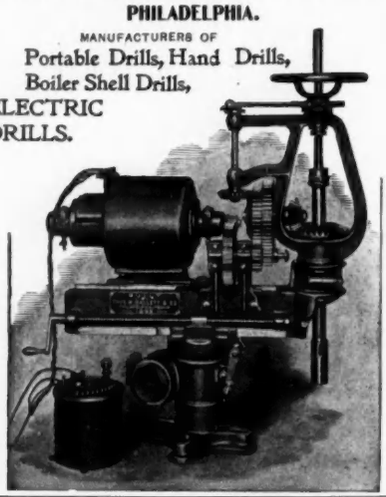

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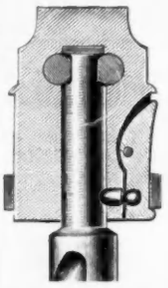

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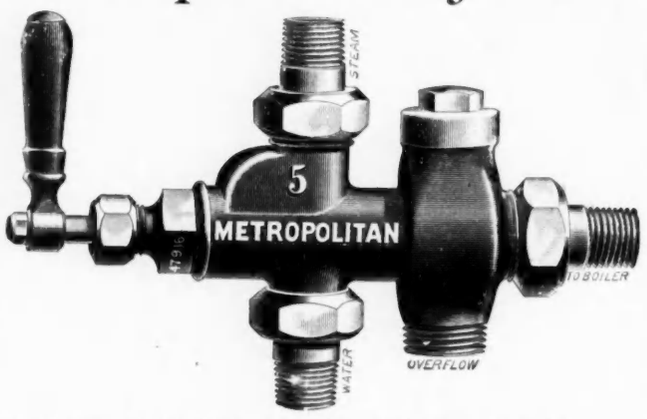

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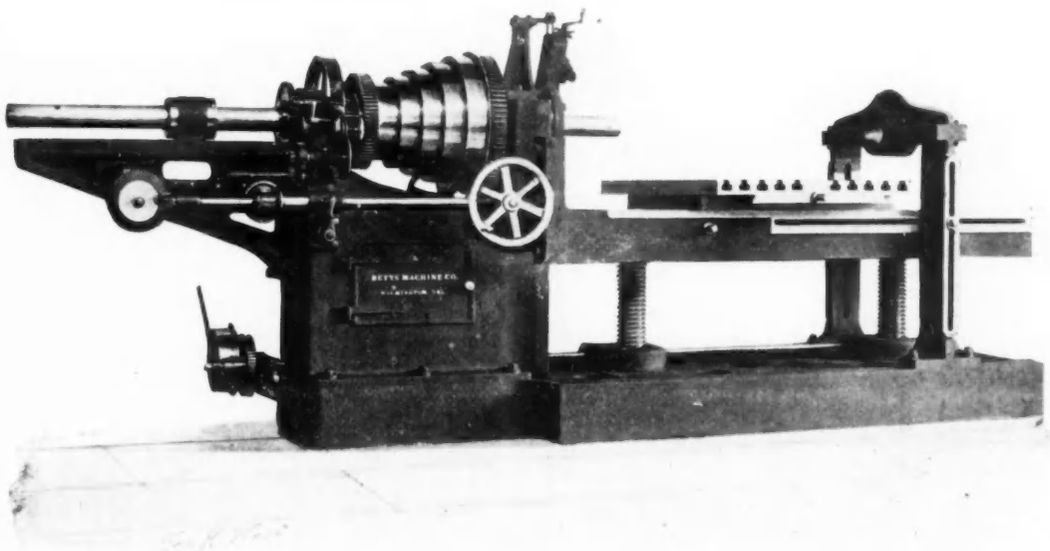

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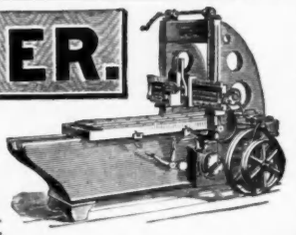

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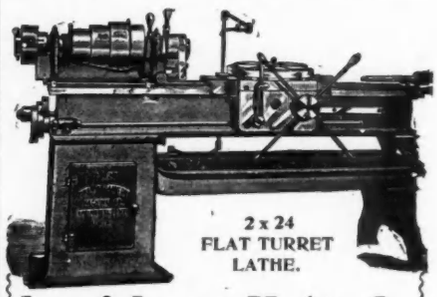

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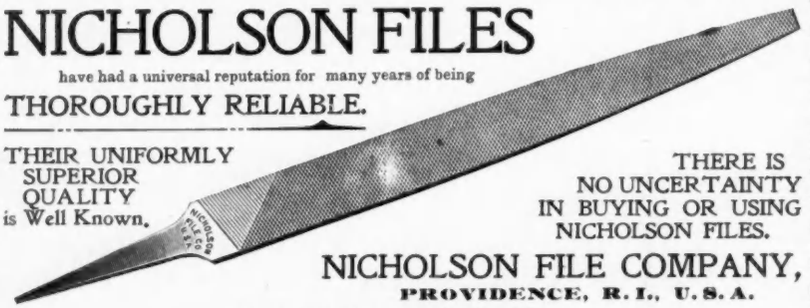

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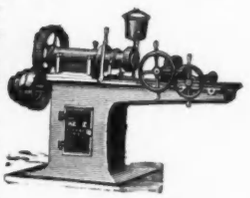

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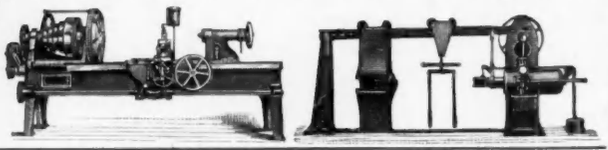

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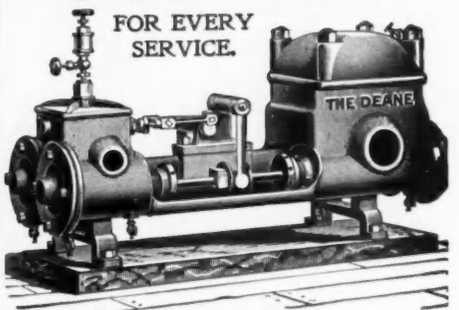

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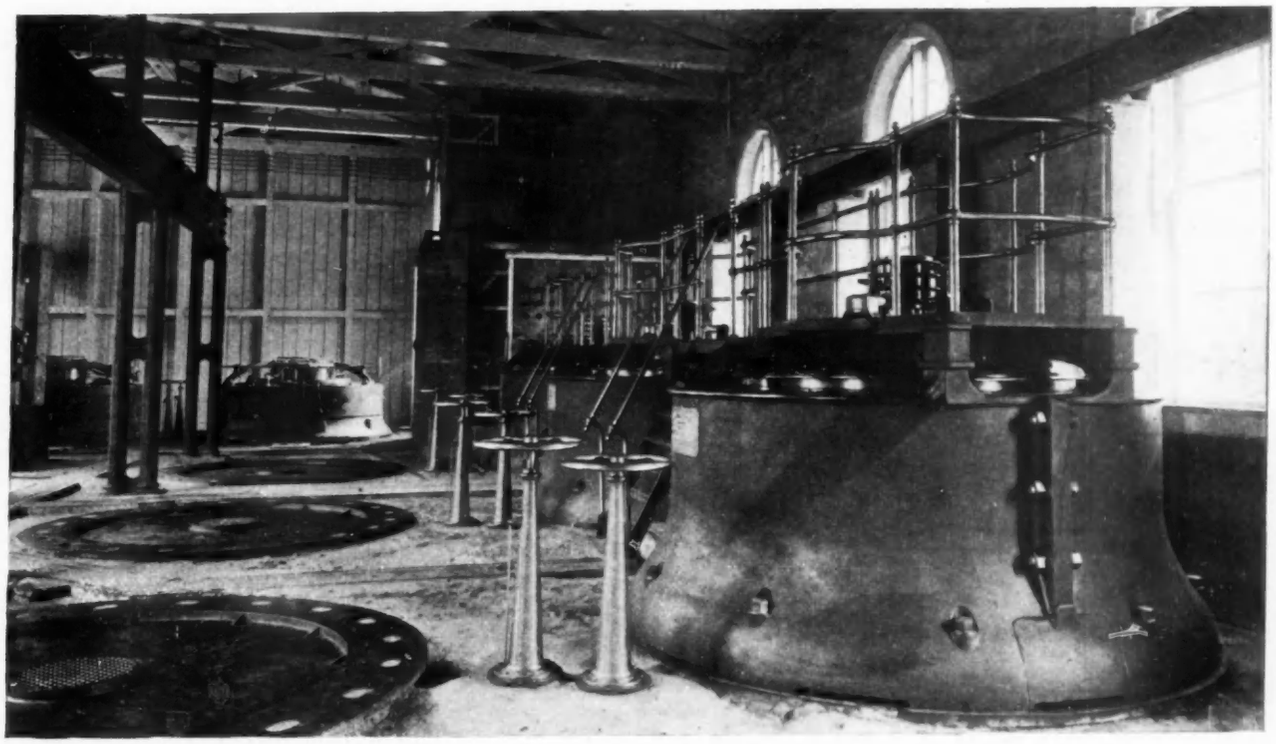
What Has Been Accomplished in the Long-Distance Transmission of Power by Electricity.

The magnitude of the enterprise has caused attention to be centered on the Niagara Falls electric power plant, and upon that feature of it which distributes a portion of the power generated to considerable distances, to the exclusion of other installations. And yet, in so far as the Niagara plant is a long-distance one, the work done up to date has been debted to the courtesy of the General Electric Company.

The Rocky Mountain region and the Pacific Slope are peculiarly adapted to long-distance electrical work, both by reason of the abundant supply of water power and the high price of fuel. Under these circumstances, it is not to be wondered at that the West has taken the lead in installations of this character, although at the same time it is impossible not to admire the enterprise and courage with because at that time it was near the limit of what was commercially feasible with the only system then in vogue, namely, the direct current. It is the introduction of the high-pressure alternating current which has increased the practicable limit of distance. This because the cost of the transmitting wire increases with the square of the distance covered at any given pressure, and with the direct current the increasing troubles with the commutator soon set a limit to the pressure which



GENERATOR ROOM OF THE PORTLAND, ORE., PLANT.

surpassed in several instances, both in the distance covered and the amount of power transmitted. Many of these plants are located in the extreme West, to which fact is probably largely due the small amount of attention they have received. We propose in this article to give a summary of what has been accomplished in this line, together with such illustrations of the different plants as will give an idea of their character and magnitude. For the photographs from which these illustrations were made, we are in- which capital has embarked on such expensive undertakings with but limited experience as a guide.

What may be called the beginning of long-distance power work was the plant of the Caroline Mining Company, at Ouray, Col., installed in 1891, in which 200 horse-power is transmitted a distance of four miles. We name this as the first long-distance power plant, not because it would be called such at the present time, but because at the time of its installation it was the longest in commercial use, and can be handled. The alternating current generator has no commutator, but instead a series of collector rings, in the operation of which there is no interruption to the current and consequent sparking, so that much higher pressures may be generated. In addition to this, the property of the alternating current of being able to be "transformed" or raised or lowered in pressure at will, comes in and renders it possible to raise the pressure on the line to a point limited only by what the insulation can stand, with corresponding

reduction in the size of the wire. For, while the alternating generator has no commutator and no interruption of the current, there are still sliding contacts which set a limit to the pressure which can be handled successfully by the generator. The generator is therefore arranged to make as high a pressure as is desired when a transformer steps up this pressure for transmission through the line, and other transformers at the other end of the line step down this pressure to a point where it can be handled by the motors. The limit of pressure which can be produced directly by the generator is, however, constantly being raised, and has now reached a point where pressures suitable for transmissions of considerable length may be produced directly by the generator. This pressure is, however, stepped down at the other end of the line in the usual way.

WATER WHEELS OF THE FRESNO, CAL., PLANT.

THE LOWELL, MASS., RAILWAY SYSTEM.

Not all of these plants are in the West, and at Lowell, Mass., is one of the first of its kind applied to railway work. The line runs from Lowell to Nashua, N. H., taking in Lakeview on the way, its length being fifteen miles. This distance is too great for economical direct-current transmission, while alternating current car motors are not yet an accomplished success. The method adopted therefore begins with a three-phase generating plant at Lowell. The generators deliver the current at 360 volts pressure, which by step-up transformers is raised to 5,500 volts, which is then transmitted down the line.

At an intermediate point, and at the far end at Nashua, sub-stations are erected in which transformers first reduce the pressure to a point (360 volts) which can be handled, when a "rotary converter," which is essentially a combined alternating-current motor and a direct-current generator built in one machine, converts the current into a direct current, with which the trolley wires are fed. The Nashua sub-station feeds not only the main line, but also the branch lines traversing the city of Nashua. The supply of current to the Lowell end of the main line is by direct-current generators having no connection with the alternating-current system. This plant was erected early in 1895 and, it will be understood, is a steam plant.

THE PORTLAND, ORE., PLANT.

This is a water-power plant, fourteen miles in length, the capacity already installed being 1,800 horse-power, the ultimate capacity contemplated being 12,800 horse-power. The normal fall of the water power is 40 feet, and the generators are normally driven direct. The turbines have vertical shafts, and the generators likewise—the armatures revolving in a horizontal plane. These generators are, of course, of an unusual type, and were designed especially for this plant.

One of the illustrations gives a view of the interior of the generator room, from which the general design will be apparent. In the background the field exciters will be seen, these being of the same general style and driven in the same way as the alternators, with special turbines of their own. At high water the fall is reduced by back water, and extra turbines are provided to drive the dynamos under these conditions. This set of turbines is larger, on account of the reduced head, and is arranged to drive the dynamos by belts—a coupling being provided by which the direct-connected wheels can be disconnected when necessary. In this plant the length of the line did not call for a voltage exceeding 6,000, which is generated and delivered to the line without the use of transformers. Transformers are, however, used at the consuming end of the line, to step down the pressure to such a point as is desired.

THE FRESNO, CAL., PLANT.

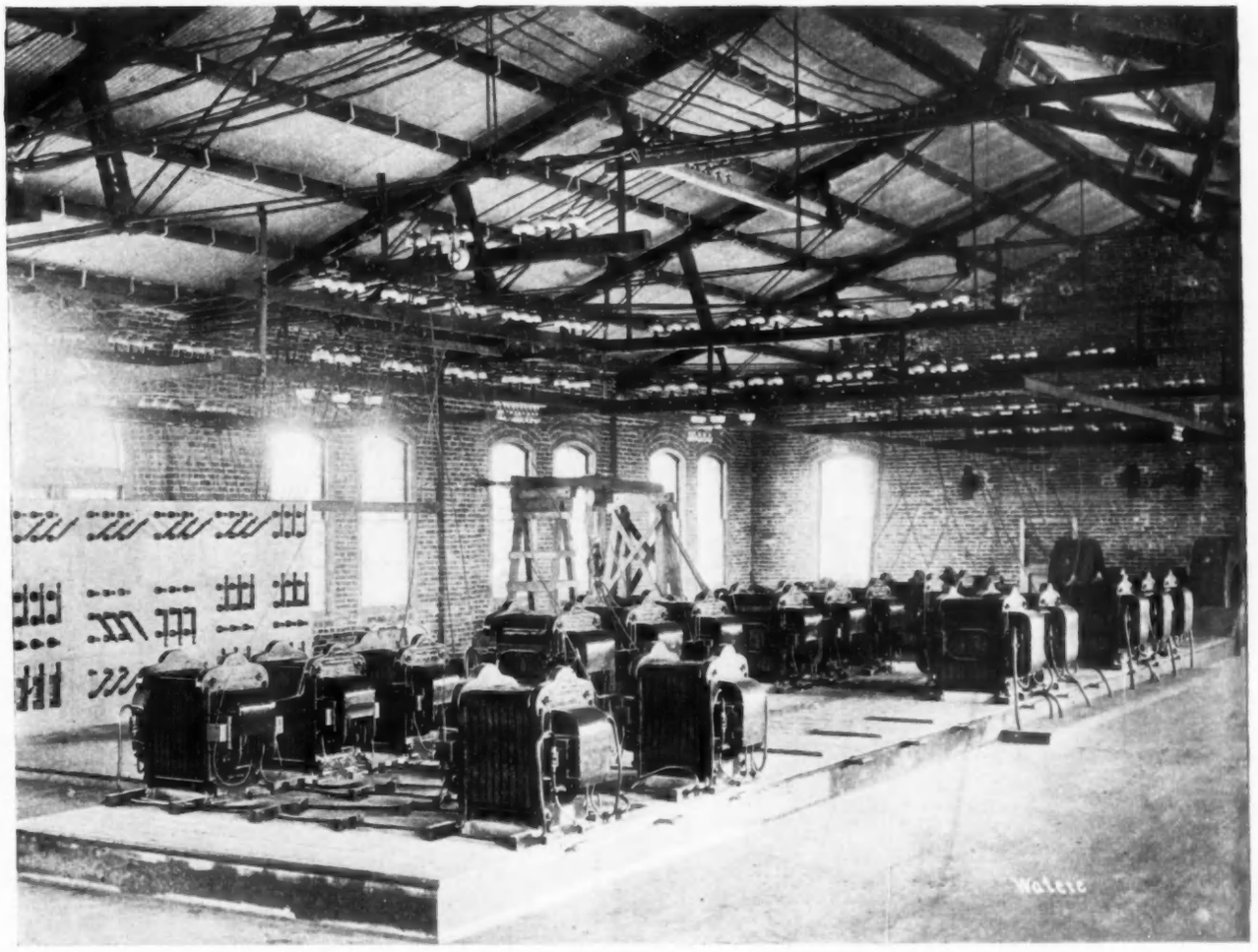
This plant enjoys the distinction of being the largest (35 miles) yet installed, as well as working under the heaviest head of water—1,400 feet, giving a pressure of 600 pounds per square inch. So far as length of transmission goes, however, the distinction will be short-lived, as this distance will soon be exceeded by the Ogden-Salt Lake City plant, mentioned below. The full power of the stream which drives the Fresno plant is 7,000 horse-power, of which 1,500 are now being utilized by three water wheels. These wheels are of the Pelton construction, having steel-plate centers and bronze buckets. They are mounted on an extension of the generator shafts, and are located outside the power house, as shown in one of the illustrations.

This plant is unusual in one respect—the shortness of the pipe line required to gain the head. The reservoir is located on the brow of a mountain, from which, in a length of pipe of 4,100 feet, the head of 1,400 feet is gained. To bring the water to the reservoir, a conduit, part

flume and part ditch, seven miles in length, has been constructed. The pipe to the wheels is twenty-two inches in diameter, and is graded in thickness, the lower end being 5/8 inch, lap-welded.

The current from the generator is at 700 volts pressure, which is raised by transformers to 11,000 volts for the line.

Three systems of distribution are laid from the receiving station at Fresno: First, a 200-volt system, covering the business part of town; second, a 1,000-volt circuit, for more distant parts of the town; and third, a 3,000-volt circuit, reaching out to the surrounding vineyards and wineries. In this Fresno station are also a series of arc dynamos, driven by motors from the transmission line.



SACRAMENTO TRANSFORMER ROOM, SHOWING AIR BLAST ARRANGEMENT.

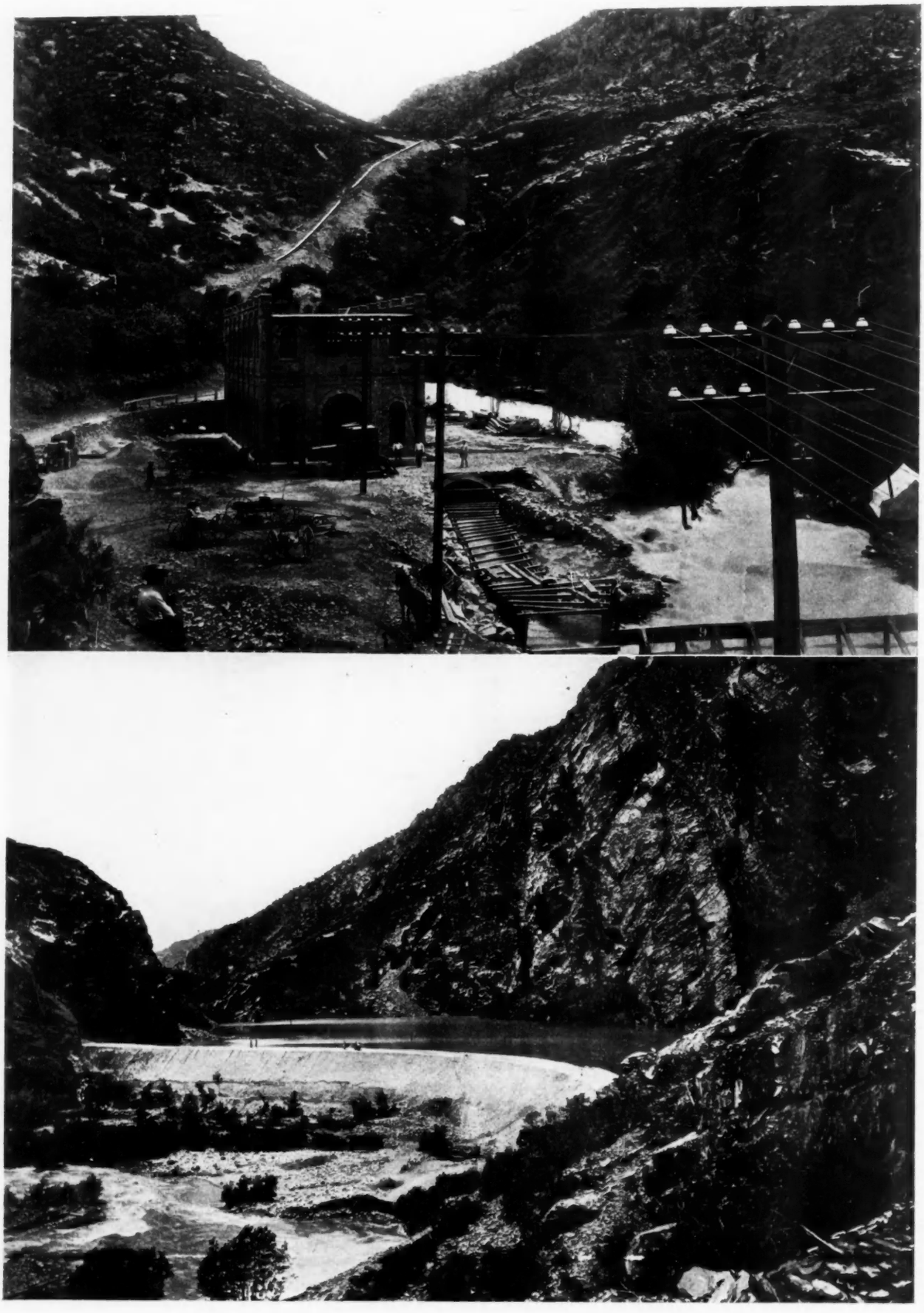
THE FOLSOM-SACRAMENTO, CAL., PLANT.

In point of power transmitted, this is the largest plant in the West, and when built it was the longest—24 miles—but has since been surpassed in length by the Fresno plant. It enjoys the additional distinction of having the largest three-phase generators (1,000 horse-power) yet constructed. It is the outcome of an old irrigation scheme, for which a company was organized twenty-five years ago. This irrigation scheme is now carried out—the water being distributed for this purpose after passing the turbines. A portion of the power is also used for State purposes at the penitentiary, and it is this triple use of the water which has justified the great magnitude of the development works. In fact, the dam and canal were built by convicts—this labor being exchanged for a site for a State prison, and the power required there. The magnitude of the work will be understood from the fact that the dam (of granite) is 650 feet long, 89 feet high, 87 feet wide at the base and 25 at the crest. The canal is 9,500 feet long, 50 feet wide at the top and 40 feet at the bottom, the depth being 8 feet.

The generators are operated by turbines mounted on horizontal shafts, which are a prolongation of the armature shafts; the wheels being placed outside the power house. The generators are three-phase, generating a pressure of 800 volts, which is raised by the transformers to 11,000 volts, which at Sacramento is stepped down to various pressures for different purposes. A view of the Sacramento transformer room is given, at the far side of which electrically driven fans will be seen, by which a blast of air is carried through the flue, over which the transformers are placed, and from which the air is discharged through the transformers to keep them cool. The current is used for power and lighting, and for operating the street railways of Sacramento. In several instances, motors have replaced steam engines.

THE BIG COTTONWOOD PLANT, SUPPLYING SALT LAKE CITY.

This is another bold enterprise, due to the labors of R. M. Jones, of Salt Lake City, and intended to utilize the power of the Big Cottonwood River at a point fourteen miles distant. It comprises a dam 535 feet long, of which a view is given, with an extreme height of 31 feet, and a rock-cut tunnel, 430 feet long, to carry the head water across a divide, down which, under a head of 380 feet, four 700 horse-power Pelton water wheels are used, mounted directly on the generator shafts. The generators are three-phase and supply current at 500 volts, which is raised to 10,500 by the transformers. About 1,200 horse-power of current is now let under contract, although the plant has been in operation since June 2d last only. The total cost of the enterprise was $325,000. It involves 224,000 pounds of copper wire, outside the apparatus, purchased. The



POWER-HOUSE, PIPE LINE AND DAM OF THE BIG COTTONWOOD PLANT.

views of the dam and power house of this plant, together with that of the flume of the Ogden plant, will serve to show the rugged character of the country in which these plants are located.

THE PIONEER ELECTRIC POWER CO.'S PLANT AT OGDEN, UTAH.

This plant is not yet in operation, but is well advanced toward completion, and deserves notice here as, when finished, it will surpass all the others in the amount of power generated, the length of the line and the voltage employed. Like the Big Cottonwood plant, it will supply Salt Lake City with power, although the generating plant is located in another city—Ogden, where much of the power will be used. Like the Folsom-Sacramento plant, its water, after doing service in generating power, will be used for irrigation purposes—18,000 acres of land in the vicinity of Ogden being reclaimed in this manner.

The hydraulic portion of the plant is of interest, as the water is to be conveyed a distance of six miles to gain the required head. This six-mile pipe is of six feet diameter, the first five miles being of wood and the remainder of steel. The dam is to be so located that it will form a storage reservoir, covering fifteen or twenty square miles. We present a very striking view of the territory traversed, in which the pipe line will be seen rounding the brow of the mountain and stretching away to the power house, which will be seen in the distance at the left of the picture.

The effective head of water at the power house will vary between 400 and 450 feet. The full capacity of the pipe will be 10,000 horse-power, machinery for one-half of which is now in course of erection in five units of 1,000 horse-power each.

The generator armatures will be mounted on the water wheel shafts prolonged, the water wheels being of the Knight impulse pattern. The generator voltage will be 2,080, which will be raised to 15,000 by transformers, at which pressure 2,000 horse-power will be transmitted to Salt Lake City. The distribution through Ogden will be direct from the generators.

Later on, it is expected to supply current to mining plants lying thirty to thirty-five miles beyond Salt Lake City, when the line pressure will be increased to 25,000 volts, for which the line and transformers are proportioned.

Space considerations have compelled us to limit the above descriptions to bare outlines of a few plants. Those given do not exhaust the list. Others which might be mentioned are plants at Hartford, Conn., 1,500 horse-power transmitted 11 miles; and Redlands, Cal., 1,100 horse-power transmitted 21 miles; beside several which have been supplied to foreign countries.

Enough has been said to show the substantial foundation on which electrical engineers base their expectations of extensive usefulness and large development of long-distance electrical transmission in the future.

The new power company at Niagara Falls have now in successful operation their new power plant, consisting of four of the Leffel Niagara type of turbines, each of about 2,200 horse-power capacity, or giving in all some 9,000 horse-power. These turbines drive eight generators of something over 1,000 horse-power each; two generators being connected directly to the shaft of each wheel, one being placed on each side. This is said to comprise the most complete and perfect electric water-power plant in the world. The same company is using in all eight wheels of the same style.

PIPE LINE OF THE PIONEER PLANT AT OGDEN, UTAH.

▲ ▲ ▲

An incandescent lamp used as a bed-warmer made trouble for Mr. Van Cott, of Unadilla, N. Y. The bulb was crushed by Mr. Van Cott's feet while he slept, and set fire to the bed-clothes. The burning bedding was thrown out of the window, but Mr. Van Cott's feet were made warmer than desired.

Long Gear Teeth.

BY HORACE L. ARNOLD.

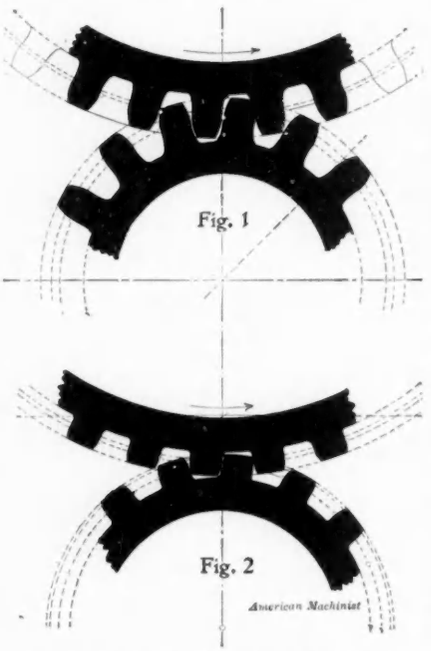
What should be the length of a gear tooth? How should the length of a gear tooth be determined? Why do we make them the length in common use?

These are certainly important questions from a machine shop point of view, because the long tooth costs more than the short tooth, and not only costs more, but is the weaker and more liable to break.

Of two wheels of the same pitch diameter, that with the longer teeth makes the most room in the machine, the most room in the sand, the most finishing in the lathe and the most work on the gear cutter, and must be the more carefully formed, because the long teeth have more points of contact than the short teeth.

Perhaps this gaining of more points of contact was the original motive for using long gear teeth. One student of gear-tooth forms, who thought deeply along the increased contact line, and used unstinted toil on the drawing-board to exhibit his conclusions, printed a book many years ago, with numerous plates showing original forms of gear teeth, all very long, having from three to eleven points of contact. The book is rare, and the author's name I have forgotten. I never saw a gear with teeth shaped according to any of his systems. But if there were really great merit in an increased number of contact points for gear teeth, it seems that the system of this forgotten student could not have passed so entirely from view.

The old millwrights who laid the foundation of much of our present practice, the men whose experience and methods were gathered by Buchanan in the successive editions of his monumental work on Millwrighting, while using both long and short gear teeth, leaned toward avoidance of tooth contact on the meeting side, before reaching the line of centers, thus reducing the possible number of points of contact by one-half, because they held that contact between the meeting teeth set up a far more injurious friction than contact on the leaving side of the line of centers, and especially because these meeting contacts, being at angles unfavorable to ease of sliding one tooth on the other, were far more likely to cause breakage than contacts on the other or leaving side of the center line. And it must be borne in mind that these early millwrights had an experience which gives great weight to their opinions. They were pioneers, each man on new ground and exercising independent thought. They were the first to abandon the use of wooden gearing and adopt cast iron as a material in place of oak, maple, hornbeam and the other favorite woods of the previous generation of mechanics. Their structures were lighter-framed by far than ours of to-day, and these early mechanicians were consequently accurately informed as to what ran hard and what ran easy, because of the lack of stiffness of supporting members, which quickly showed faults of the moving parts carried by them. These old, original millwrights, whose rule-of thumb-work laid the foundation for our established practice—men whose records of their own individually adopted dimensions form, in many instances, the warrant for rules and formulas in use to-day—believed in making the driver of a pair of gears a little greater in pitch than the driven wheel, so as to avoid contact before the teeth reached the line of centers, and, probably to still retain as many points of contact as possible, made their gear teeth long, to increase the points of contact on the leaving side. There is also a gain, or what was deemed a gain in early days, in making the driver pitch greater than the pitch of the driven wheel, in the way of decreasing the tendency of the gears to separate from each other, which is very great in case the teeth form contacts on the meeting side of the center line. Where the tooth contacts are all on the leaving side of the line of centers, the gears have less tendency to separate; but, on the contrary, sometimes hug together, and such gears are in use to-day, the driving pinion having a greater pitch than the driven wheel. All of this practice has long since passed away, so far as ordinary gear cutting is concerned; but we still retain a long gear tooth, the length being commonly such as to give two teeth in contact when a 12-tooth pinion is used.



GEAR AND PINION WITH LONG AND SHORT TEETH.

There is comparatively little danger of breaking the teeth of machine-tool gears as now made. Our early tool-makers of Fitchburg and Worcester were believers in fine pitches, and a broken gear tooth was a common enough thing in our early machine-shop experience. We have passed that fault, in a great measure; although in some cases the tendency to use a too small pitch has not altogether disappeared from American practice. But we retain the long tooth; not so long as the extreme English practice, perhaps, but yet longer, in my opinion, than either theory or economy seems to warrant.

Why should we pour needless iron into gear-blank rims and turn up the increased surface, simply to take heavier cuts on the gear cutter? Not only do we have more stock to cut out of the gear blank, but we have to cut it with a far weaker mill than could be used were the teeth as short as they can be made without detriment, say the length shown in Figs. 5 and 6, which perfectly constrains the positions of a pair of 16-tooth pinions. In case a gang of tooth-cutting mills is used, more teeth can be cut at one passage of the gang if the teeth are made short. It is the points of the teeth which require very accurate shaping to avoid noise and shock in action, and the shorter the point the less noise the gearing will make, provided the tooth be kept long enough to perfectly define the positions of the pair of wheels working together. There is a visible economy in every step of gear production and gear use to be had through the employment of short gear teeth, provided the short gear tooth will run as well as the ordinary long gear tooth.

The friction is less in case of the short tooth. Many persons think the teeth of gears roll on each other, and some highly esteemed text-books say distinctly that such is the case, and that correctly formed gear teeth do not slide on each other. In Fig. 1, which is a drawing of a 32-tooth wheel, driving a 16-tooth pinion—epicycloidal teeth with the ordinary diametral pitch, or "Manchester rule" length—the first contact on the meeting side shows the point of the pinion tooth touching the wheel tooth at its pitch line. These two teeth are supposed to remain in contact until at the line of centers the pitch circles of the wheel and pinion touch each other; consequently, the two teeth must slide on each other the whole length of the points of the teeth. Fig. 2 shows teeth half as long, drawn to the same curves as the teeth of Fig. 1, and in the same relative positions. These teeth are just long enough so that there is no loose place between a 32-tooth wheel and a 16-tooth pinion. These gears present a very absurd and highly "unmechanical" appearance. We are slaves of the eye, no less in machine design than elsewhere. There can be no manner of doubt that the pair of wheels in Fig. 2 will work with less loss from friction than those in Fig. 1; they are not half as likely to break, and they do not cost half as much in tooth-cutting; they weigh less, and take up less room; and if they will transmit motion as smoothly, and last as long without wear-

ing out, as the long teeth in Fig. 1, they are in every way to be preferred. As the short teeth are subject to much the lesser amount of friction, and that less amount of rubbing occurs at a more favorable angle, it would seem certain that the short teeth would be the more durable in action.

All of the points of contact in the teeth of a pair of gears, move at different relative velocities, varying from nothing in the line of centers to the maximum. Under these conditions the wear must be the greater where the speed of the rubbing surfaces is the higher. This must, it seems, be the actual working condition of gear teeth. They must wear at different points of contact with a rapidity directly in proportion to the loaded surface velocity. If such is the case, then points of contact added by tooth-length beyond what is needed to have the relative position of the gear and pinion constantly defined in both directions, are only needless aids to injurious friction.

The teeth shown in Fig. 2 are probably shorter than would be advisable in general practice, as a pair of 16-tooth pinions should be perfectly constrained; that is, should have no loose place at any point of revolution. But the length need be but very little more than is shown in Fig. 2 in order to secure this constraint.

The Birmingham Foundry, Birmingham, Conn., is one of our very old millwrighting concerns. It began making heavy gears in the days when millwrights were still independent investigators, and it has a rule of its own for laying out gear-tooth shapes, to which it yet rigidly adheres. Like all other old millwrighting and engineering establishments, the Birmingham Foundry has a large collection of gear patterns, and some of these, made no one knows when or by whom, have extremely short teeth. The standard Birmingham tooth is, however, rather long than short, as is shown in this scale drawing of a pair of gears, which I copied in 1894, when an article from the pen of W. H. Booth in this paper first directed my attention to the length of gear teeth, and the seemingly erroneous theories as to the action of gear teeth on each other, which were then and still are commonly entertained by gear-makers generally. Of the gears shown in Fig. 3, both driver and driven are the same pitch, and the only unusual feature about them is the rather long teeth and the width of face, which is nearly four times the pitch.

Fig. 4, which shows the teeth same pitch, and curves about two-thirds the length of the teeth of Fig. 3, gives the same number of points of contact as in Fig. 3, has considerably less sliding friction, and also has a very much greater strength of tooth. The work on these gears was unusually severe, as it was liable to vary from nothing to the full power of the engine almost instantaneously, the work being, I believe, thrown on and off through rigid clutches. A previous pair of wheels, of the same diameter and pitch, but less face, had failed, and the gears shown in Fig. 3 were a repair.

Perhaps the shorter teeth of Fig. 3 would, shrouded as they are, sustain much more than double the blow which the long teeth could endure safely, and I cannot see any reason whatever why this special pair of gears should have had longer teeth than are shown in Fig. 4.

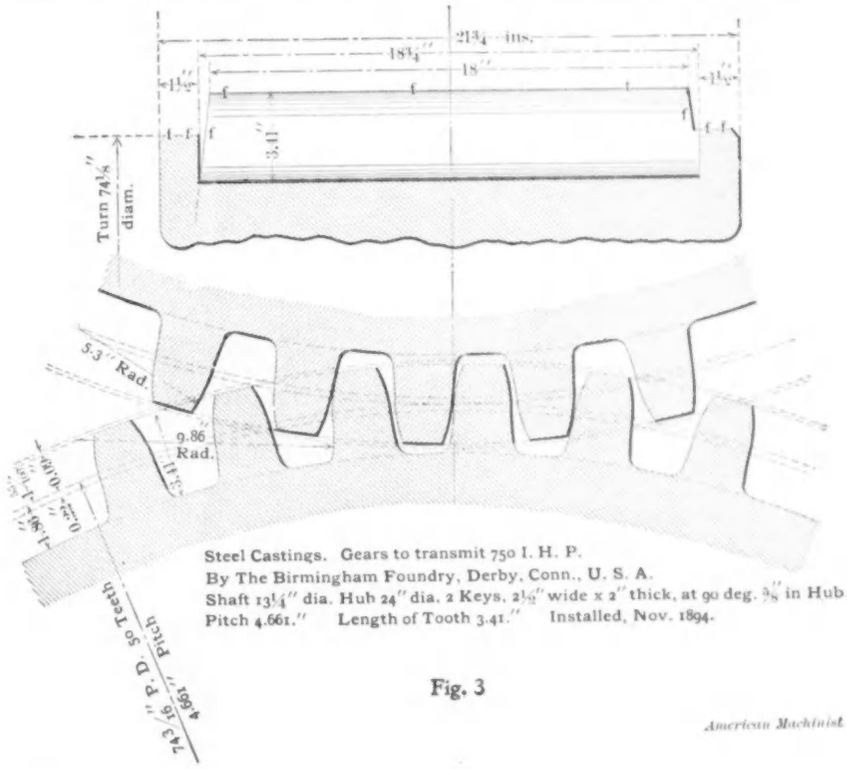

21¾ ins.
18¾"
18"
3.41
Turn 74⅛" diam.
5.3" Rad.
9.86 Rad.
Steel Castings. Gears to transmit 750 I. H. P.
By The Birmingham Foundry, Derby, Conn., U. S. A.
Shaft 13¼" dia. Hub 24" dia. 2 Keys, 2½" wide x 2" thick, at 90 deg. ⅜" in Hub
Pitch 4.661." Length of Tooth 3.41." Installed, Nov. 1894.

Fig. 3

American Machinist

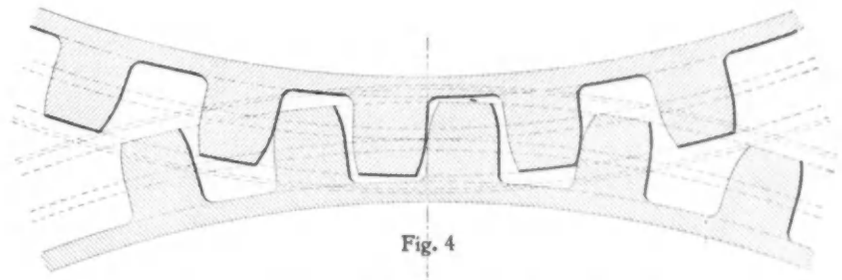


Fig. 4

Same as Fig. 5, except that the tooth is made ½ the pitch in total length, and the clearance is reduced in proportion.

American Machinist

What is more to the point, no one at the Birmingham Foundry could assign any cause for a supposition of superiority of the long teeth, nor give any reason for adding the confessedly weakening increase of length.

Since my attention was drawn to this matter of tooth-length by Mr. Booth's article, I have asked many designers of gears why they made long gear teeth, and have never had any answer which in substance amounted to more than a quotation of precedent, or the evidently true assertion that shorter teeth would not look right.

An imposing list of authorities might be quoted, all delineators of long teeth, and makers of repute, but the actual requirements of the problem of power transmission by toothed wheels.

The only certain and convincing test possible is the extended use by some courageous concern of gear teeth very materially shorter than those now commonly made. It is absolutely certain that no scientific test could settle the matter finally, because it is clear that such a test must show in favor of the short teeth, and no laboratory dictum would ever modify the propensity of machine designers to make things that "look right" because they have long been seen in connection with high-class work.

As a suggestion for trial length, I add

Figs. 5 and 6, showing two positions of the teeth of a pair of 16-tooth pinions. The length of tooth is made such that with one tooth in mid-line position, as in Fig. 6, the outer corners of the points of the coacting teeth lie in the pitch circle of the other gear. This gives a longer tooth than that shown in Fig. 2, and a tooth which I now believe to be amply long for silence and durability. If Figs. 5 and 6 are compared with Fig. 1, the economy of production and the increase of strength gained by the Fig. 6 length, over that in common use, as shown in Fig. 1, will at once become apparent.

I do not believe any good argument can be brought forward to sustain the use of gear teeth longer than those shown in Fig. 6.

▲ ▲ ▲

Meeting of the National Association of Manufacturers.

The Executive Committee of the National Association of Manufacturers met in Philadelphia, on December 18th ult. Their proceedings were preparatory to the annual convention, which will occur in Philadelphia on January 26, 27 and 28, 1897. The convention will be held in the new Horticultural Hall, which will provide ample accommodation for a large assembly. The Executive Committee extends a cordial invitation to all manufacturers of the United States, members or non-members, to attend this convention.

▲ ▲ ▲

Practical Testimony on the Motor Carriage.

Engineers and mechanical experts may indorse and recommend as honestly and as industriously, as they will, but the final say is with the public. Those who are directly or indirectly the recipients and beneficiaries of any improved service are the ones to determine its adoption. The following from "Truth," London, is of great practical weight so far as it may be truthful and disinterested.

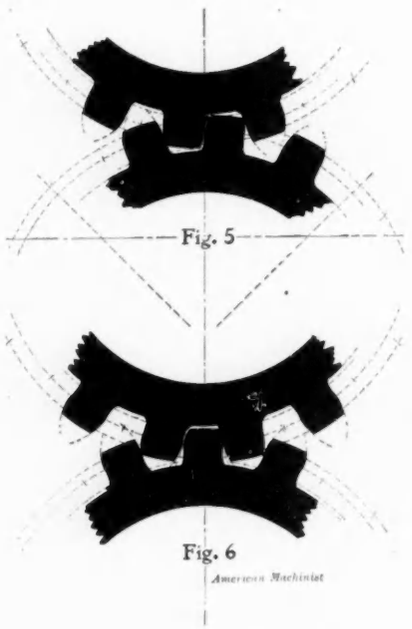
"The object of a carriage is to convey people and goods. The carriage is to my mind the best that, at least cost, adequately fulfils this object. If motors, by all means let us have motors. Last Saturday I betook myself to Westminster Bridge to see the procession of these vehicles on the way to Brighton. I was disappointed. No one seems to have grasped the fact that there must be a new departure in their form. Judging from those in the procession, their makers have simply sought to make them as like carriages drawn by horses as possible. Apart from form, the lighter ones seemed to vibrate greatly. By my side stood a talkative lady whose acquaintance I had not previously enjoyed. 'If the people inside of them were cream,' she said, 'they would be butter before they got half way to Brighton.' I suggested to her that the petroleum cars smelt unpleasantly. 'Stink,' she said, 'is the word for them,' and it certainly was."

▲ ▲ ▲

Twenty-Fifth Anniversary of the Stevens Institute of Technology.

A noteworthy event in the annals of technical education in the United States will be the forthcoming celebration of the twenty-fifth anniversary of the Stevens Institute of Technology, on the 18th and 19th of February next.

The festivities will consist of a banquet, at the Hotel Waldorf, New York, to which representative engineers and technical educators throughout the country will be invited. On the following day the institute will be open for inspection,



RECOMMENDED TEETH.

and the methods of instruction, together with the apparatus in the various laboratories, will be explained.

Not the least interesting feature of the exhibition will be the collection illustrating the work of the alumni, and consisting of machinery, apparatus, drawings, etc., representing the product of their activity during the twenty-five years.

The festivities will also include a reception, to be tendered to the faculty, graduates and undergraduates, by Mrs. E. A. Stevens, widow of the founder of the institute, at Castle Point, Hoboken. A promenade concert and dance in the evening will conclude the celebration.

The Stevens Institute has always taken high rank among the institutions devoted to technical education in the United States, and its twenty-five years of successful effort is amply exemplified in the work accomplished by its graduates in all departments of mechanical and electrical engineering.

More Cheap Oil.

We are receiving a number of letters written by the Reliance Oil & Grease Company, of Cleveland, O. (J. M. Bachert, manager), which letters all make practically the same statement, to the effect that the afordsaid oil company had shipped a half barrel each of two different kinds of oil, and after shipment had discovered that the "party" to whom these half barrels of oil had been consigned had no good financial standing. The aforesaid half barrels are therefore offered to the persons to whom these letters are addressed at considerable reduction in price. A good many of our friends have received these letters and have promptly mailed them to us, and we take occasion to advise the Reliance Oil & Grease Company, of Cleveland, O. (J. M. Bachert, manager), that good business practice would dictate that the commercial standing of parties to whom goods are shipped should be ascertained before shipment is made. At any rate, it is evident that our friends do not want the oil offered and think that there is an "African in the fence."

▲ ▲ ▲

Those who think that no particular skill or knowledge is required in the management of milling machines might reflect a little on a case which came under our observation recently, where, in a large and, in the main, well-managed manufacturing establishment, a new man put in charge of a department in which many milling machines were employed, found twelve milling machines constantly in use on a certain operation and always behind the rest of the work. By altering methods he made three machines do this work easily, and greatly reduced the cost of cutter-making at the same time. If you are a shop manager, are you sure there are no places in your shop where similar improvements might be made? Unless you are sure of it, the chances are that some other shop is beating you.

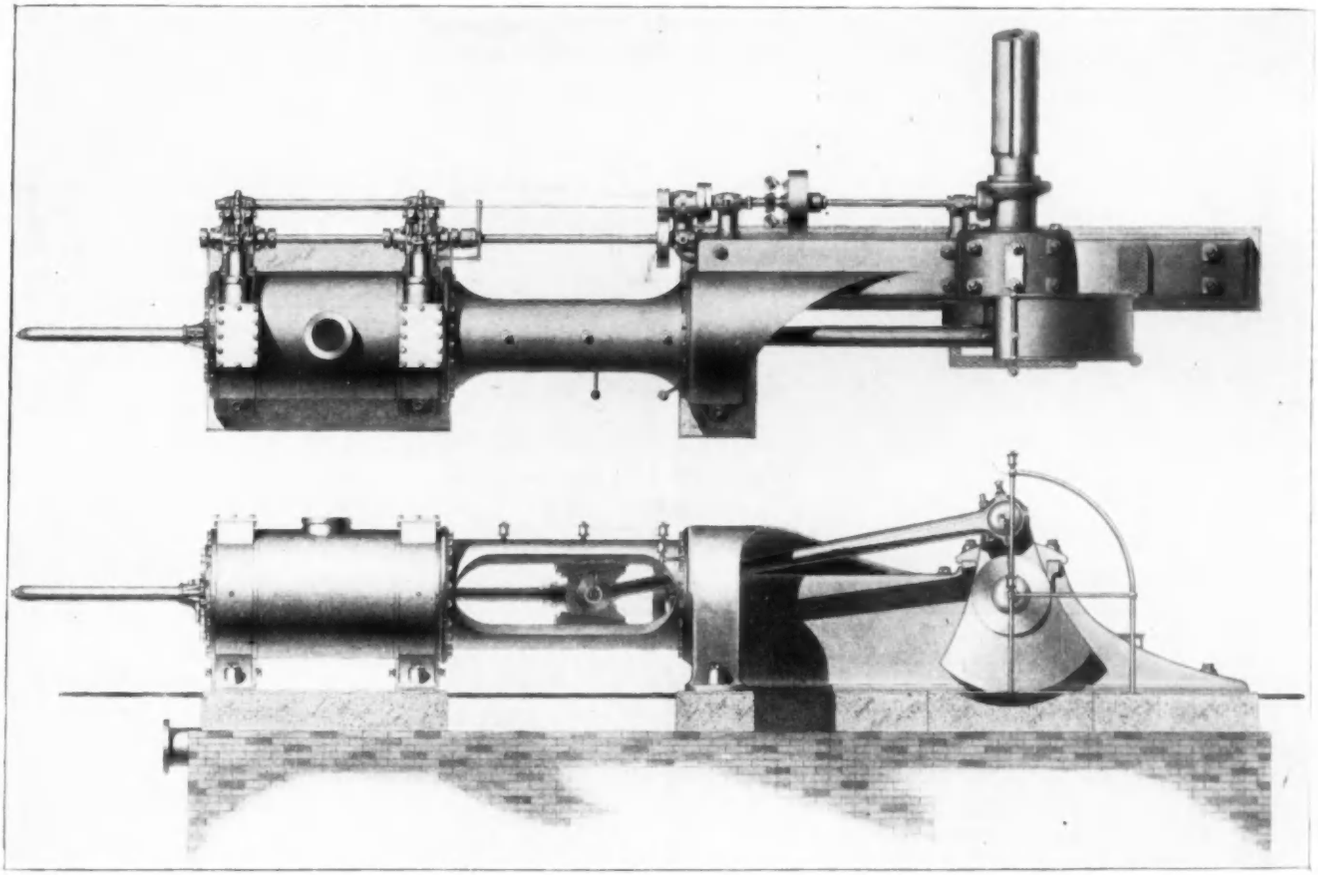
▲ ▲ ▲

The burning of the Newark electric light plant was the occasion of some lively hustling on the part of the company owning the same. The towns of South Orange, Vailsburg, Irvington, Bloomfield and Harrison were supplied from the same plant and were plunged in darkness together. An old and disused plant at Harrison was started, and soon provided light for that town and for part of Newark, as the plant had more capacity than was required at Harrison. Two other old plants at Boyd and Orange streets, Newark, were also started up, and a plant at Orange which had a surplus of capacity was connected up to the surrounding towns. Meanwhile, and before the fire was extinguished, machinery had been ordered from Cleveland, Fort Wayne and Pittsfield, on special trains, and sufficient to supply all deficiencies.

A Novel Engine Design.

We take pleasure in laying before our readers the accompanying views of a novel steam engine, reproduced from the original drawings of the designer. The excellent half-tone, giving the plan and elevation of the engine, is not reproduced from a photograph of an actual engine, as some might at first think, but from a shaded drawing, which shows excellent technical skill and patience in execution.

The design of the engine, which is 24 x 48 inches, embraces a number of novel and interesting points. It has been intended to combine the essential elements of high steam economy over a wide range of action, high piston speed and an arrangement of details that will encourage manufacturing operations and keep the cost of building down to the minimum.



A NOVEL ENGINE DESIGN.

Referring to Fig. 1, it will be noticed that both the admission and the exhaust valves are circular gridirons, oscillating crosswise of the cylinder upon circular seats, giving free passage for the steam with a small movement of the valve and with small clearance. Motion is given to each valve by a horizontal valve stem, bell crank and a small independent eccentric for each, adjustably secured to the eccentric shaft, which runs along parallel to the cylinder and at the same central hight. This shaft makes the same number of revolutions per minute as the main shaft, but its rotation is not uniform, as will be described.

There is a steam dash-pot on the valve stem of each of the admission valves. Steam at boiler pressure is maintained in the enlarged or cushion chamber, where its action on the unbalanced area of valve stem and dash-pot plunger exerts a force tending at all times to close the valve. The inner surface of the compression chamber is serrated to within ¼ inch of the bottom, and when the compression plunger reaches this point, the steam is compressed, checking the momentum and bringing the valve to rest without shock. A small controlled by-pass allows a slight escape of the steam and prevents rebound.

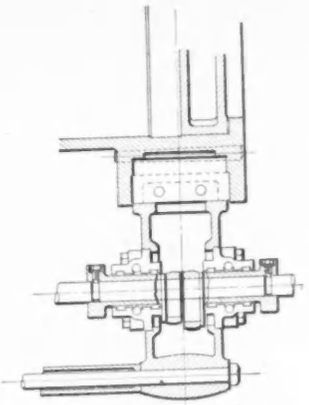
We cannot attempt to describe the releasing gear here. It is simple, compact and adapted to the quick action required. By the use of sectors on the bell crank, the valve rod is moved in a straight line.

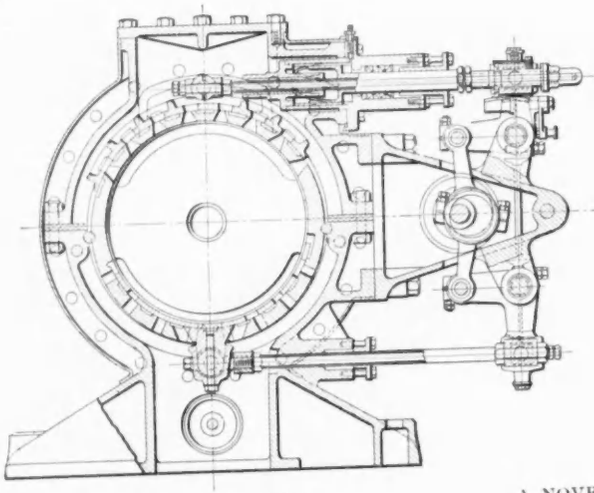
The steam and exhaust valves are made in halves, and are easily accessible by removing the steam chest covers and cylinder heads, respectively, as shown in the sectional end of Fig. 2.

Each eccentric has a sleeve which goes through the bearing in the valve-gear brackets, with a boss and set-screw outside, by which each may be set independently. The valve motion is derived from the main shaft by means of bevel gears. The first shaft, parallel to the center line of the engine, runs at double the speed of the main shaft, and upon this shaft is the governor, which is of the Hartwell type, and is essentially that used in the Willans engine, with the addition of an inertia weight to quicken its action. Being positively-driven, perfect immunity from runaway is assured the engine.

Next to the governor shaft and parallel to it, but not exactly in line, is a short shaft which is driven by the governor shaft, by what is essentially the Whitworth quick-return motion, and this short shaft being spur-geared two to one to the eccentric carrying shaft, the latter is given the same revolution as the main shaft, but its movement of rotation will have four distinct phases, two of which are quick and two are slow, the setting of the eccentric shaft being such as to utilize this peculiar motion to the best advantage, this being made possible by the fact that the steam and exhaust eccentrics are nearly opposite. In the plan, a light rod is seen which connects the governor with the valve-tripping mechanism.

The design of the connecting rod is deserving of notice. Both ends are similar except in size. Both boxes and adjusting wedges are circular steel castings, the former lined with hardened babbitt, and both are formed by splitting eccentric bushings and reversing one-half of each. The boxes are provided with bosses pro-





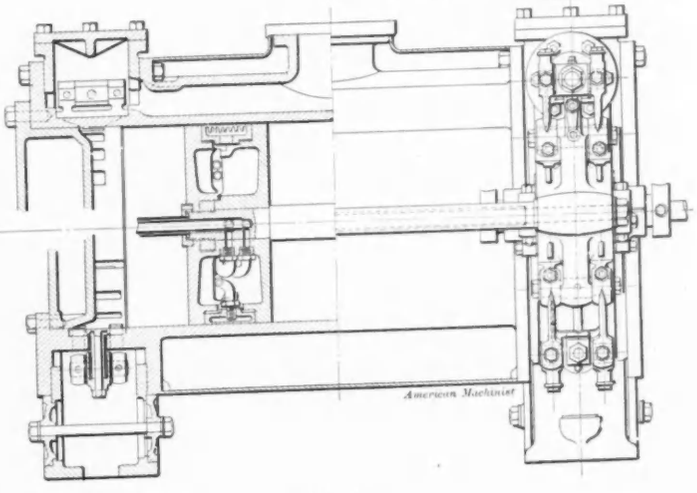
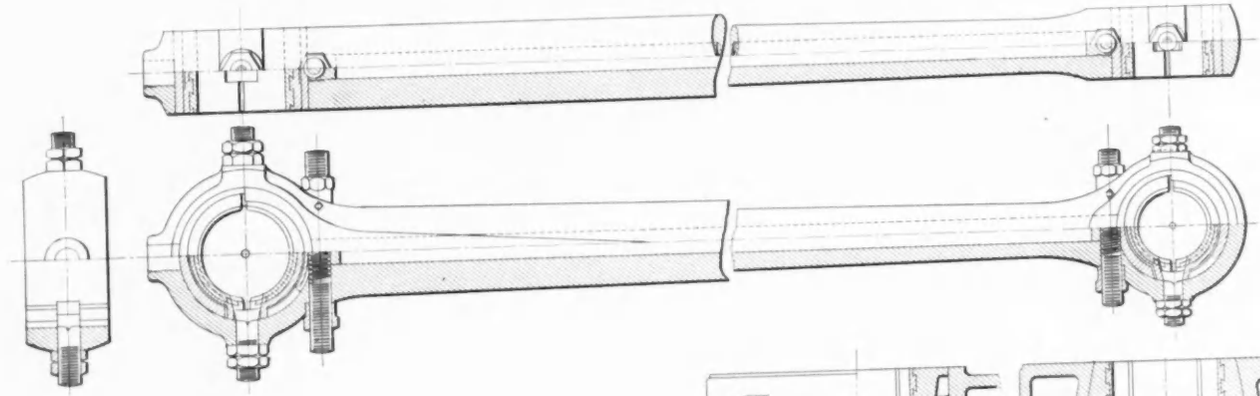
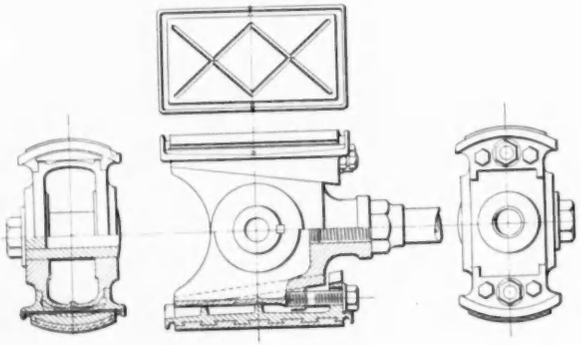


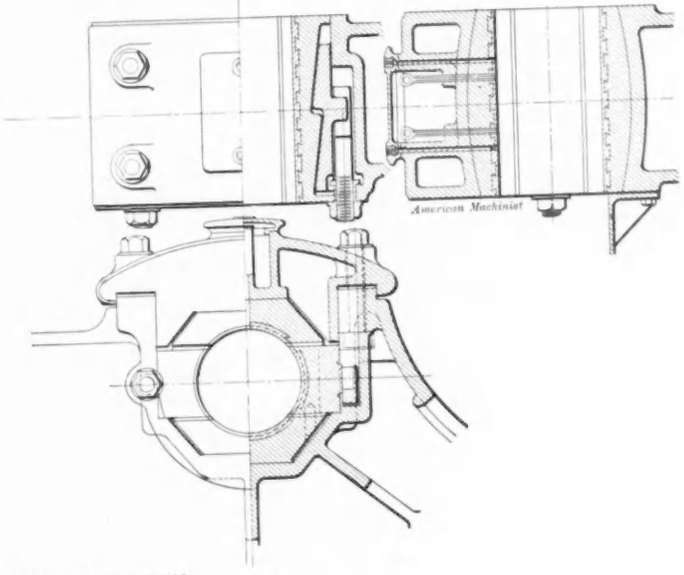
Fig. 1.

A NOVEL ENGINE DESIGN.

Fig. 2.







DETAILS OF ENGINE DESIGN.

jecting through slots in the wedges, and engaging in direct shear large hardened steel steady pins. Adjustment of the boxes is secured by rotating the circular wedges, by the device shown, through an angle of 40 degrees.

The construction of the crosshead and main bearing is clearly shown in our cuts; the oil from the top crosshead shoe is collected and delivered to the pin bearing, and thence to the lower shoe, this feature forming a part of the system of double-oiling which has been carried throughout the design. The adjustment of the quarter boxes of the main bearing is done by wedges moving parallel to the axis of the shaft. In consideration of the enormous weight of armatures or fly-wheels in direct-connected engines, with the springing of the shaft and the desirability of securing a perfect alignment and full bearing in such cases, the bottom shaft boxes are placed on bored seats; and to secure interchangeability, the top boxes are similarly formed. The main bearing foot is thrown well out to secure a liberal support upon the foundation at this point of greatest weight.

The piston shown, while not an essential feature of the engine, shows an interesting attempt, other than steam-jacketing, to reduce the losses due to cylinder condensation. The device consists of a broad bronze piston ring, its inlet end being in communication with the steam supply by means of the hollow piston-rod extension, its discharge communicating with the annular space between the two tubes of which the back piston rod is composed. At every revolution of the engine, communication is made that discharges the water of condensation from the steam ring. The joint of the ring is at the bottom, where it is provided with means to limit its expansion and pressure against the cylinder. The object of the device is to precede the incoming steam, dry the water from the cylinder walls, and impart a wave of heat to the previously chilled surface.

The proposed speed of the engine is 135 revolutions per minute, or 1,080 feet of piston travel—somewhat quick for a releasing gear engine; but the valve is light and directly connected to a small, light and quick-acting dash-pot, the power of which is always proportioned to the resistance to be overcome. The catch-plate of the releasing gear is not influenced by centrifugal force, and, being light, is prompt action is not impeded by its inertia.

The total clearance with 3-16 inch between piston and cylinder head is 1 1-10 per cent. of the piston displacement. Compression is carried to admission pressure.

In connection with the design of the engine, a careful study has been made of the weights of the reciprocating parts and of the inertia effects, with diagrams, which we could not spare space to reproduce, showing the approximate equalization of the crank thrusts. The diagrams show that, by selecting the best available materials of construction, a weight of reciprocating parts has been secured which, at the given speed, results in a remarkably uniform pressure throughout the stroke.

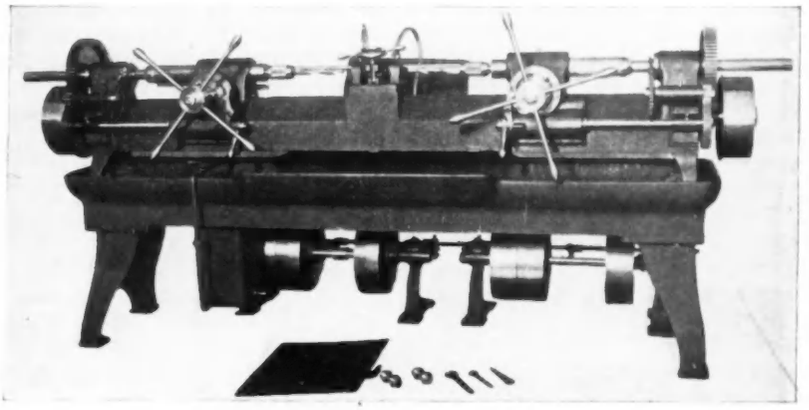
The engine has been designed and drawn by Mr. L. Hollingworth, Jr., 282 Columbus avenue, Boston, Mass. We understand that patents have been secured, or are pending, upon the novel features of the design.

▲ ▲ ▲

Double-Head Drilling Machine.

This machine was designed and built especially for drilling bicycle wheel hubs, crank-hangers, etc., but is, of course, as well adapted for any drilling of that class requiring a through hole, or holes drilled from opposite sides in line with each other.

The machine is shown with the fixture for hubs in place. The hub is clamped and drilled from each end, and as the points of the drills approach each other, the feed of one is first released and the other then completes the hole, the first-mentioned drill being then backed out by means of a connection between the pilot wheel shafts, shown at the back of the machine. This prevents collision of the drills.



DOUBLE-HEAD DRILLING MACHINE.

The machine will drill work 9 inches long and is geared to have about the driving and feeding capacity of a 30-inch driller. The feeds are driven by chain and sprocket wheels, and the worm shafts have ball thrust bearings.

It will be noticed that the bed is so formed on top as to prevent the lodgement of chips and oil, and it is closed at the bottom to give maximum stiffness.

A large chip-pan is provided below the bed, and an oil pump forces oil through Almond tubes to the drills. The machine is made by the Garvin Machine Company, New York.

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The Hughes Steam Pump Company, of Cleveland, O., are sending out a little pocket diary which is likely to be appreciated by those fortunate enough to receive it. We understand it is sent gratis, and it is well worth having.

Pneumatic Versus Hydraulic Power Distribution.

BY FRANK RICHARDS.

In "Cassier's Magazine" for December there is an extremely interesting paper by E. B. Ellington, Memb. Inst. Civ. Eng., giving an account of the hydraulic power supply in the city of London. The hydraulic power works in London were established in 1882, have been growing ever since, and, as the writer says, the system now is the biggest thing of its kind in existence. It is said to be not only the largest distribution of power from central stations in any city of the world, but it is, excluding smaller installations in other cities, the only instance of a power distribution which furnishes a power supply exclusively. It carries neither light nor heat, the power of refrigeration or anything else, and yet it is found to pay.

The system as employed for conveying power does not even provide power for general use, but almost exclusively for one specific purpose, that of hoisting. There are in London eighty-six miles of mains, about 10,000,000 gallons of water per week are supplied under the constant pressure of 750 pounds, and the available horse-power at the four stations established is 3,800, which is soon to be increased to 4,600. The present income from the power supply is over $375,000 per annum, and the use of the service is increasing more rapidly each year.

The present uses of the water power furnished are nearly as follows:

Passenger lifts	650
Freight lifts and cranes	2,000
Presses of various kinds	90
Motors	95
Fire hydrants	80
Total	2,915

The motors used are Pelton wheels, which are said to be giving very satisfactory results; yet it is added that the high speed at which these motors have to run, and the small diameter of the jet for small powers, makes perfect governing with a

consumption of power proportional to the load a difficulty.

This very clear and authoritative statement of what is actually being done in the way of power distribution by means of water under high pressure seems to invite some comparison with the possibilities of compressed air for a similar service. The lowest price at which the pressure water is delivered to customers in London, and, as argued by the writer referred to, the lowest rate at which it is possible to deliver it without loss, is 36 cents per 1,000 gallons dilevered at the constant pressure of 750 pounds. The British imperial gallon is 277.274 cubic inches. Then 277.274 : 1,728 : : 1 : 6,234 gallons, which equals one cubic foot, and the cost of 1,000 cubic feet will therefore be $6,234 \times 36 =$ $2.25. The foot-pounds in 1,000 cubic feet delivered at 750 pounds pressure will be $144 \times 750 \times 1,000 = 108,000,000$, and this divided by $2.25=480,000 foot-pounds for 1 cent.

Now, our assumed price for compressed air, supposing a public compressed air service to be established, is 5 cents per 1,000 cubic feet of free air, compressed and delivered at a pressure of 100 pounds. One thousand cubic feet of free air, after compression and cooling, will be 114.7 : 14.7 : : 1,000 : 128 cubic feet of compressed air.' The foot-pounds, then, in 1,000 cubic feet of free air compressed to 100 pounds pressure, or of 128 cubic feet of compressed air at that pressure, will be $144 \times 100 \times 128 = 1,843,200$, and as the price of this is 5 cents the number of foot-pounds furnished by the compressed air for one cent will be $1,843,200 \div 5 = 368,640$.

From this it is seen that the actual foot-pounds imparted by 1 cent's worth of compressed air is less than the foot-pounds conveyed by water pressure for 1 cent. The cost per foot-pound of air pressure will be 1.3 of the cost for water pressure, and the water pressure in foot-pounds will cost .768 that of air.

In comparing the relative ultimate cost of air pressure and of water pressure for power transmissions, there are other conditions which come in to modify the case and to materially affect the result. As has been said, the water supplied under pressure by the London company is used almost exclusively for lifts or hoists, and the employment of water certainly possesses one important advantage in lifting, hoisting or pressing cylinders. Little water, or practically no water, is sacrificed for filling clearance spaces. Those spaces are constantly full of water, and for any movement of a piston caused by the water pressure, the volume of water used is always practically identical with the piston displacement for the given movement. If a piston with an area of 1 square foot were moved 1 foot by the water pressure, the water required to do it would be 1 cubic foot and no more. I of course, do not here speak of what might leak by the piston, or through the stuffing boxes or leaky joints in the pipes.

Having said thus much for the water, the rest of the account between it and compressed air for power transmission is all the other way. The use of water at constant pressure for hoisting purposes (practically the only use of it which more than a dozen years of established service in London and other cities has developed) entails enormous waste of power, from the fact that however much the load may vary the same volume of water must be used for an equal movement of the piston. With a constant water pressure as a basis, and with varying loads to be handled, the apparatus must be designed for the heaviest load, which will be the exceptional load; but every load, however small, hoisted by the apparatus will cost as much in power, or in water, which in this case represents power, as this exceptionally heavy load. If we have a 10-ton hoist it will cost as much to hoist 10 pounds with it as it will to hoist the 10 tons. In a passenger elevator, or lift, there will be as much water registered by the meter, and as much water to pay for, when the car goes up a given distance empty, when it carries one passenger, or when it carries as many as it will hold.

With the use of compressed air the case is entirely different. The air used for lifting will always vary with the load, and the pressure of it in the hoisting cylinder will not be the full supply pressure, but only the pressure necessary to balance and move the load. It is quite probable that in general hoisting the average load raised will not be more than one-half of the maximum load; then only one-half the gage pressure will be required, and only the volume corresponding to that pressure will be used. With a standing pressure of 100 pounds, if only 50 pounds is required in the hoisting cylinder the volume used will be inversely as the absolute pressures, or 114.7 : 64.7 :: 1 : .564.

In hoisting this will be only a little affected by the cooling of the air. The wire-drawing of the air during admission to the hoisting cylinder will heat it somewhat, and also the slow action of the hoist usually gives the air sufficient opportunity to recover its normal temperature. The air has a decided advantage over water in many cases, from the fact that it is so much livelier in its action. The elasticity of the air is only occasionally an objection to its use for hoisting, and when this objection is imperative, water may be employed in the hoisting cylinders, while the pressure may still be furnished by the air. In this application the water is, of course, used over and over again, and therefore costs nothing. The use of pressure water instead of compressed air, of course, involves the conveyance of waste water to a sewer or elsewhere, and wherever the slightest leak may occur, the water must always be considered more or less of a nuisance; while not the slightest objection is ever made to escaping or discharged air, and in many cases it is welcomed as a positive benefit.

A supply of compressed air will do all that the water will do in the way of hoisting or pressing, which is all that the water can undertake to do, and the work of the air is then only just begun. The air may be sent much more rapidly than water through the pipes, so that smaller pipes are sufficient for the same service. It is also of importance that air pipes are always ready for the most sudden or intermittent service, while the stopping or starting of long columns of water is a serious matter, and even changing the speed of flow cannot be done very suddenly.

Compressed air may be employed not only for hoists as the water is, but for every other application of power where it is absolutely impossible to use the water pressure. The air will not only do all that the pressure water will do, but also all that steam will do in the line of power transmission, and for small amounts of power or for intermittent service it will be always and instantly ready, and yet will cost nothing except when actually employed, and in a strict ratio to the amount of power furnished.

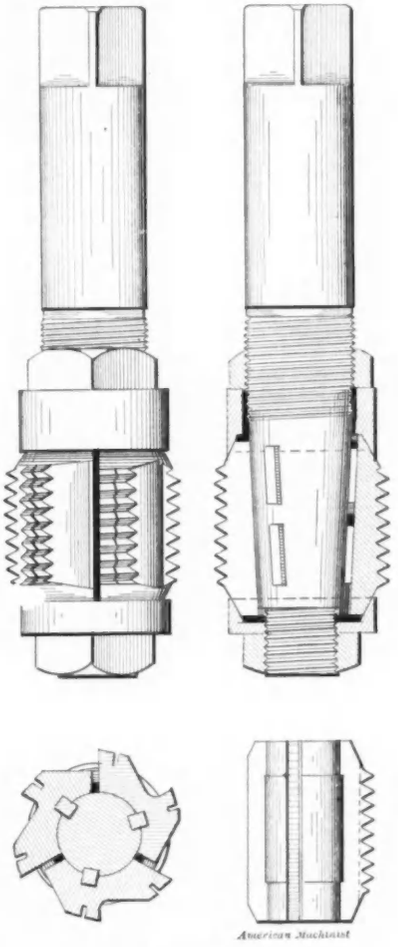
Of the numerous other applications of compressed air which belong to it alone it is not necessary to speak here. That there is a great field of usefulness for a public supply of compressed air if once established and maintained seems to be quite evident, and it seems to be equally evident that such a service should prove remunerative to any company that should, under wise and strict management, engage in its establishment; and no better evidence is required than the success of the hydraulic service in London. It is quite probable that for the same business area a compressed air service would develop ten times as much business as is developed by the water system, and it is very certain that an American city would give it far greater employment than any city of the Old World.

▲ ▲ ▲

The monthly returns of the English trade unions show a steady increase in the state of prosperity of the manufacturing industries of Great Britain. The Amalgamated Society of Engineers has but 2.3 per cent. of its membership out of work from all causes, while in the Manchester district this figure sinks to 1 per cent. The Steam Engine Makers' Society reports but ¾ of 1 per cent. of its membership out of work. Unusual activity prevails in all the engineering and marine centers. Why should England, and in fact Europe generally, be enjoying a period of unusual prosperity while we are still more or less in the doldrums? There seems to be no good reason for this, and perhaps we ought to consider that encouraging. But of course there is a reason, good or bad.

A New Sectional Expansion Tap.

We illustrate an adjustable expanding tap for which a patent has been recently issued. Scarcely a word of explanation is required, as the cuts show every feature of the invention very clearly. There is a taper stem with a thread above and below



AN ADJUSTABLE TAP.

it. The thread-cutting portion of the tap consists of three sections, each section carrying two principal cutting faces, with a secondary cutting face only a small distance behind each, and a thin chip slit in front. These secondary cutting faces constitute a part of the invention, and we call the attention of our readers to them accordingly. Each cutting section has taper ends, over which a conical cup fits and secures them, the adjustment being made by the nuts upon the tap stem, outside the conical cups. The stem has splines for each of the cutting sections, and a corresponding groove the whole length of each section permits them to be moved longitudinally as required, and still causes them to turn all together with the stem. The patentee is Benjamin W. Prentice, Worcester, Mass.

▲ ▲ ▲

Improved Square.

Geo. A. Snyder, of Grand Rapids, Mich., proposes to make an improvement upon a well-known machinist's tool by arranging it as shown in the accompanying engraving.

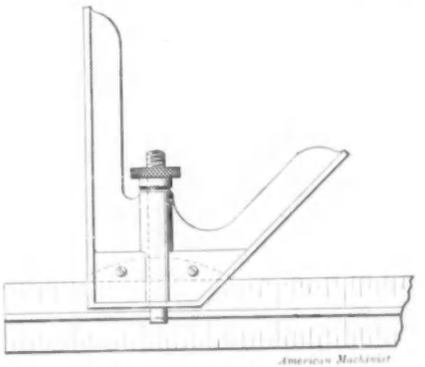
The blade, instead of being grooved longitudinally, has, in place of the groove, a raised rib, this form of blade permitting the use of hard steel for the purpose. Then, instead of the blade resting against the bottom of a groove milled in the head, and depending for accuracy solely upon the accuracy of the milling, it rests in this case upon the edge of a hardened piece of steel, the other edge of which is an arc of a circle, as shown by the dotted lines, and thus, by means of tapered screws which pass through this piece, it can be adjusted either to be precisely square or to give a small amount of angle; as, for instance, in gaging the draft on a pattern. The screws are made to adjust by the simple expedient of having the taper holes through the steel plate slightly closer together than the holes through the head, so that when one of the screws is loosened and the other one tightened, the piece is moved endwise, and, of couse, its straight edge is correspondingly inclined. It is proposed to make the heads of drop-forged steel.

▲ ▲ ▲

Chas. Churchill & Co. are sending out an elegantly printed circular, illustrating and describing their new quarters at 9 Leonard street, London, which is a building specially adapted to their business of handling American machinery and tools. The building includes 12,474 feet of floor space, and is fitted with a hydraulic crane for handling goods outside the building—i. e., between trucks and any floor—and a hydraulic elevator inside for both passengers and goods.

A Simple Gas or Gasoline Engine.

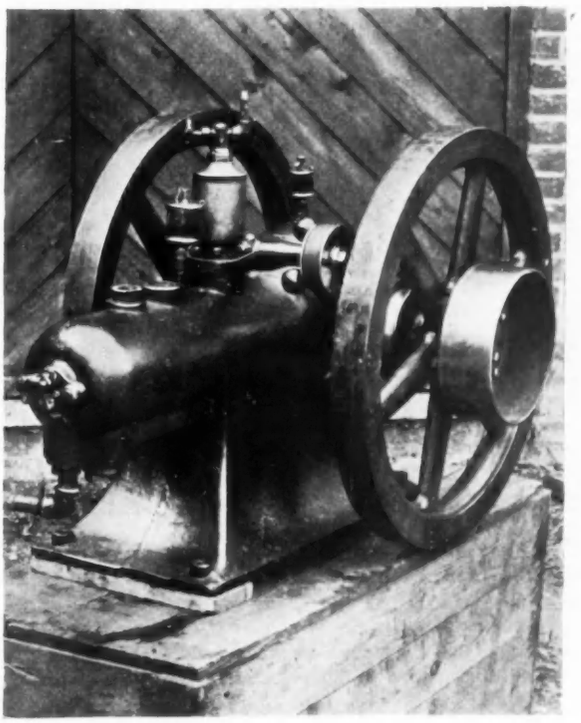
The gas engine herewith illustrated seems to be one of the simplest that has ever come under our notice. It is of the type in which the explosion and impulse occur at each revolution of the crank, and the entire cycle of operations is accomplished without a valve motion or any



IMPROVED SQUARE.

of the usually more or less complicated mechanisms.

The construction and operation of the engine will be readily understood by reference to the vertical section, Fig. 3. It will be seen that, except the moving parts, almost the entire engine is comprised in a single casting. The cylinder is differential, having the larger bore *D* and the smaller bore *G*; the chamber in which the crank revolves is also inclosed and carries a light air pressure for a purpose which will appear later. The gas or gasoline, under a pressure sufficient to cause it to flow, passes from the supply pipe



A SIMPLE GAS ENGINE.

through the adjustable needle valve *a*, and then intermittently through the valve *b* into the mixing chamber, where it mingles with a sufficient quantity of air, and then passes the valve *c* into the cylinder *D* behind the piston as it advances. The suction caused by the advance of the piston opens the valves *b* and *c*. The piston reaches the end of its forward stroke and begins to return, and, as the valve *c* is closed, the mixture of gas and air passes through the passage *E* and by the valve *f* to the exploding chamber *G*, at the completion of this return stroke being compressed to about four atmospheres. Just before the completion of this return stroke, a projecting point at the back of the piston trips the igniter *H*, producing a spark which ignites the explosive mixture, causing a great increase of pressure, which acts upon the piston to drive it forward. The pressure, falling by expansion, continues to act upon the piston throughout the forward stroke, and at the end of the stroke the port *i* is uncovered and the contents of the cylinder are discharged. In the meantime the air-tight chamber in which are the crank and connecting rod, has been filled with fresh air, entering through the check valve *j*, and it has been compressed sufficiently to give a current through the passage *k* and by the valve *l* into the cylinder and chamber *G*, sweeping out the products of the previous combustion and filling with fresh air The complete cycle of operations, it will be seen, takes place during the two strokes of the piston, or one revolution of the crank, so that for each revolution the same may be repeated. It will be seen that the action will be just the same whichever way the crank turns, so that the engine will run in either direction without changing anything upon it, by simply starting it in the direction required. The governor acts by controlling the supply of gas or gasoline admitted.

The engine is claimed to give the greatest amount of power for given floor space, weight and cost, and with good fuel economy. Either the electric spark or the tube igniter may be used. The engine is built at the Garrett Engine, Boiler & Machine Works, Garrett, Ind.

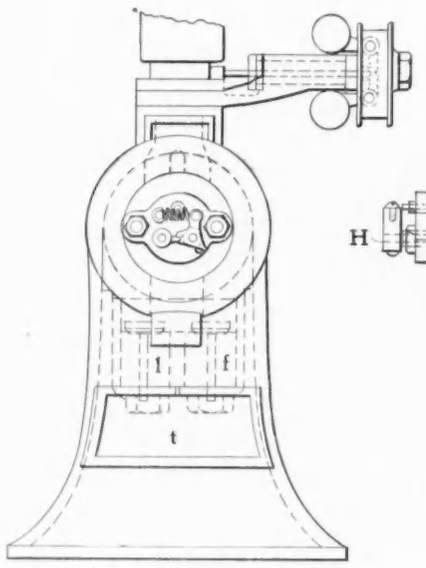


Fig. 4

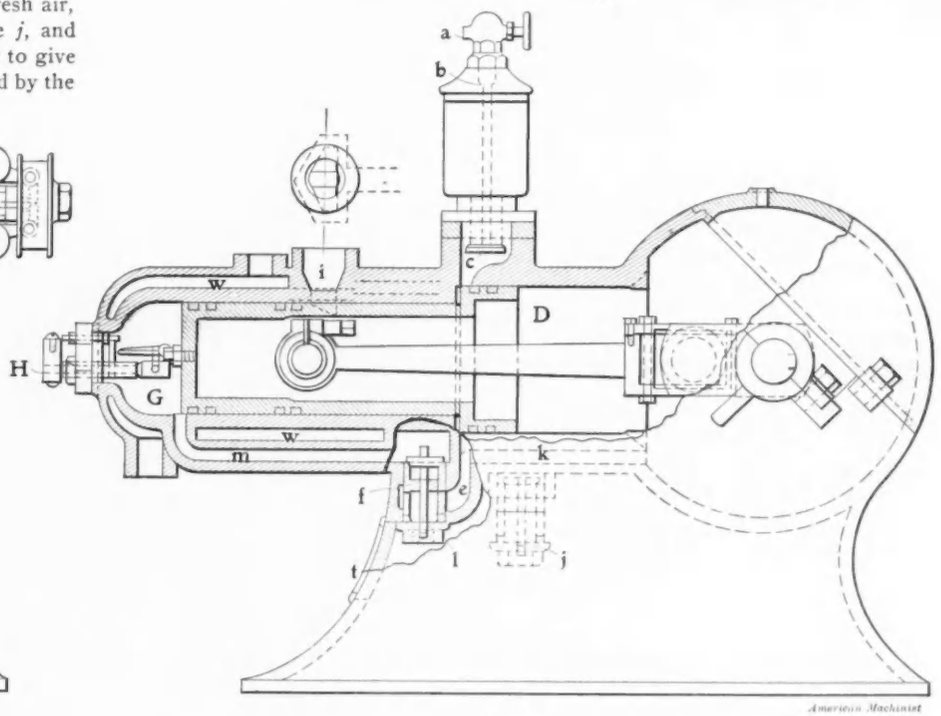


Fig. 3

A SIMPLE GAS ENGINE.

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Mr. A. D. Pentz, who is well known to many of our readers, and who was for a number of years with the Singer Sewing Machine Company at its Elizabethport factory, returned to the Singer Works on January 1st, after an absence of some eight years, during which time he has been in various positions, the last being with R. Hoe & Co., of New York.

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It is rumored that the Elswick firm of the Armstrongs and that of Sir Joseph Whitworth, the largest gun-making concerns in England, have amalgamated.

Letters from Practical Men.

Solid Crosshead Pins.

Editor American Machinist:

Mr. John Randol gave us an interesting article in his account of the crosshead wrist truing device in use at the De La Vergne Refrigerating Machine Company's shops. The job of turning or of otherwise rounding and truing up crosshead pins that are cast solid in the crosshead, is always an interesting one, and a great many

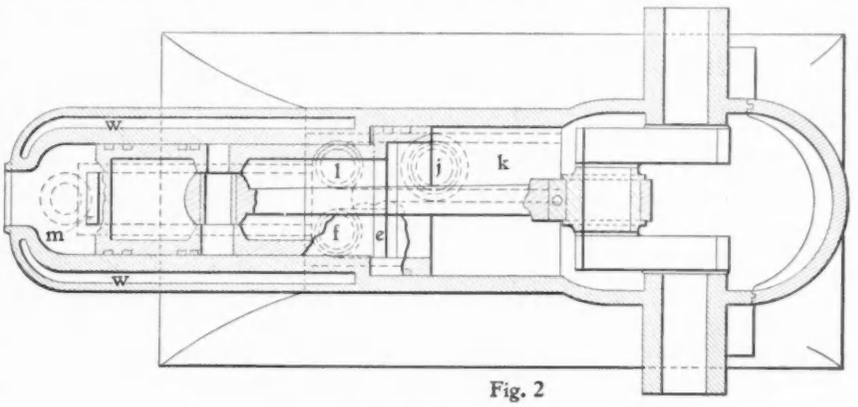
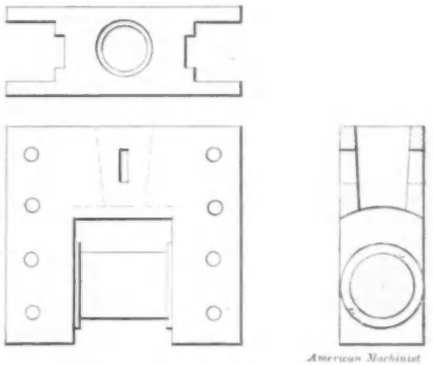


Fig. 2

machinists know something about it, especially the old-timers. The style of crosshead in which the cast solid pin was found I used to admire as a beautiful and exhausive example of what ought not to be. I have seen a great many such crossheads made, very near like the sketch herewith. There was a lot of useless metal in them in some spots, and still they had several weak places, and in use showed several different modes of breaking down. Sometimes, or oftener, the piston-rod ends were made with too little taper, and

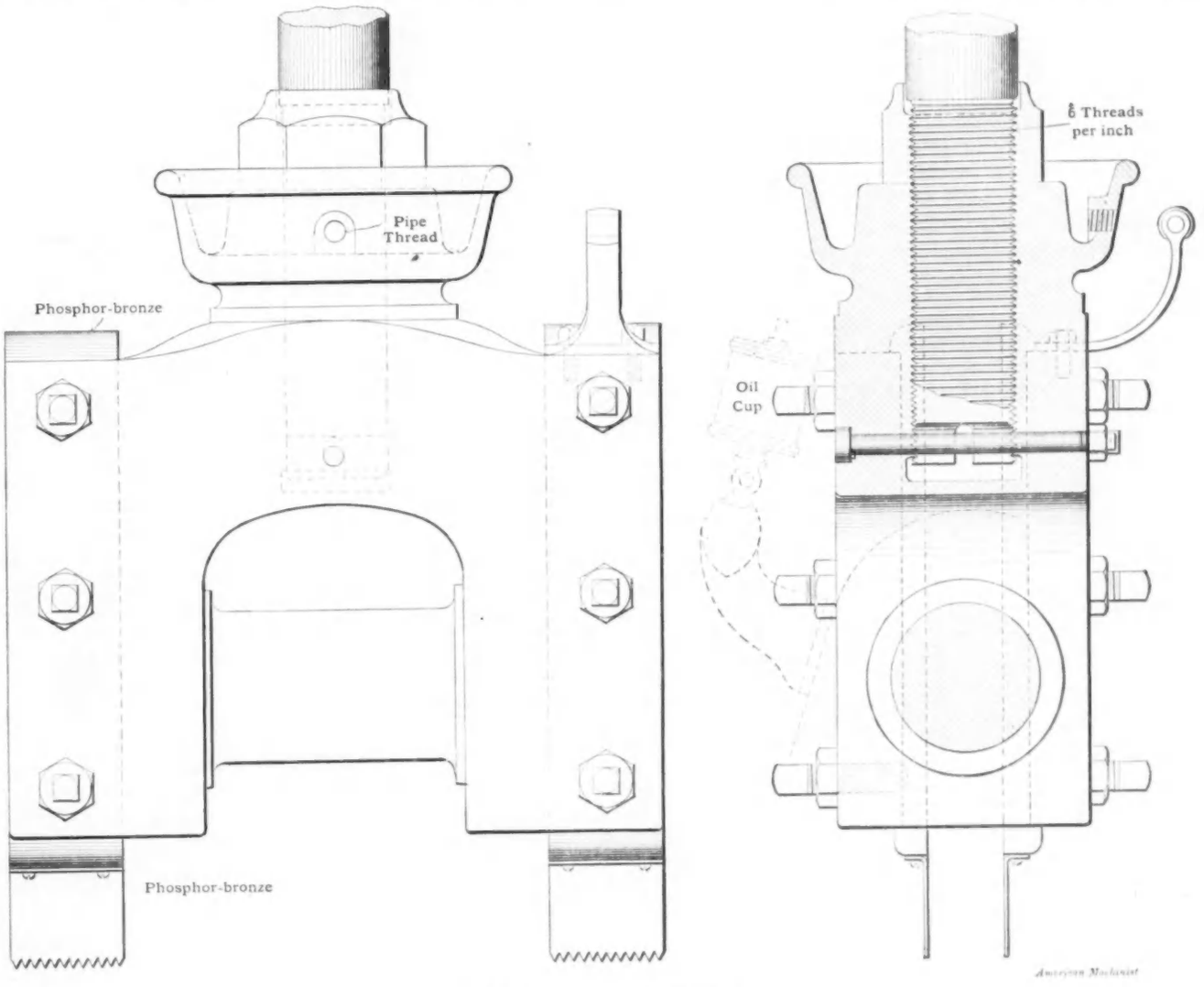
they would keep driving down into the crosshead until they split it in that way. Then next time, when the hole and the rod end were made with a good deal more taper, a piece would be broken out where the draw of the key came, and that crosshead would have to be thrown away. Then the wings that carried the side gibs would break off. These wings were usually made with lips at the edges, projecting inward to keep the gibs from sliding out sidewise; to save something on the planing, the lips would be discarded and the gibs would be kept in place by drilling holes half way through them for the points of the adjusting screws to drop in, and then after running a while, if the gibs were taken out, they would show that they only bore on a little round spot under each screw and would soon wear through. As the pin was located so near one end of the crosshead, there would, of course, be more pressure on that end of the gibs, and the piston rod was always being sprung more or less in consequence.

The crosshead on which the wrist-pin turning rig is employed, as shown by Mr. Randol, is practically the same crosshead as the one in my sketch, and could be used in precisely the same place; but most of the objectionable features that I have spoken of seem to have been eliminated, which is no small achievement in engineering. That the engineer of to-day is able to get reliable steel castings where before nothing but cast iron was available, gives him a great advantage; but the rest of the improvement in design may be said to be the product of pure thought stimulated by unfortunate experience.



AN OLD STYLE CROSSHEAD.

In connection with this crosshead pin I may perhaps be permitted to remark that if Mr. Randol would kindly tell us how in the olden time they used to turn the solid wrist pins "with a 'reach-up' tool half way around, and with a 'reach-down' tool the other half way," he would be revealing a mechanical curiosity and he would be gratifying the curiosity of a mechanic. When he shows me how it was done I will know more than I do now. We used to mount the crosshead on the centers and use, in the first place, a diamond point with the point quite high. Then, as the crosshead could be turned back considerably beyond the horizontal, or until it struck the rest, and forward until it struck the screw of the tool-post, the part turned would be about what is shown between the two marks on the sketch. The crosshead was then reversed on the centers and turned the same distance on the other side, and the "reach-up" tool had only to do what was left, one-half of it on one side, and the other half on the other side, when the work was reversed on the centers again. Even with the "reach-down" tool, which I never before heard of anybody using for



DE LA VERGNE CROSSHEAD.

this purpose, it would not have been practicable to turn the pin all the way round without reversing it on the centers, and if that were done, a "reach down" tool certainly was not needed.

I notice that another correspondent, writing upon this same subject, says that the pins should be finished somewhat oval instead of round. He, of course, does not mean precisely that, as no box could work properly upon any part of a pin that was oval or elliptical in shape. The oval pin would touch the circular surface of the box along a line only, just as a cylindrical surface in contact with a flat one touches. All that can be said in this direction is that if the pin is expected to wear rapidly it should be made as large as possible in diameter, but always truly circular where the thrust or pull of the rod would come. Cutting away at the side of the pin, either by flattening it or by a re-entrant curve, is always a very proper thing to do.

TECUMSEH SWIFT.

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School Draftsmen.

Editor American Machinist:

I have read your article in regard to school draftsmen in the issue of October 29th, and would like to say a few words on the subject. You ask if there is any mechanical school that turns out students capable of taking positions as competent draftsmen. I do not think there are many such schools in existence, and I am acquainted with the courses in drawing and the equipment of a large number. It is not generally considered to be the province of an ordinary drawing school to turn out draftsmen who can go into a machine shop and do competent work without some other experience, and for this there are quite a good many reasons, some of which I will try to give.

The art of showing the construction of a machine is not such a simple one as you would indicate. The art of making straight and curved lines is simple; but when one comes to show the inwardness and outwardness of a machine, the problem becomes more complicated and varies in intricacy, of course, with the character of the machine. In order to do satisfactory work in a drafting room, a man must have not only a trained hand, but a trained eye and mind. In everything he draws he must see beyond the surface of his paper. His practiced hand may draw perfectly; but the alert mind, carrying the details, thinking out the best and cheapest methods of construction, is the principal thing to train. And this is what the majority of schools do not do.

All students of mechanical drawing, we will admit, are acquainted with the principles of projection, and perhaps, also, of descriptive geometry; but there are but few cases where they get anything but theory until they go much farther than the school course will carry them. Until that course ends they have been making lines and pictures, which, although they may represent to the eye and mind some actual object which may be constructed, yet, as draftsmen, they cannot be called competent until they have made drawings which they have followed from the pattern shop or smithy through the machine shop to the packing room.

The elementary or theoretical work is absolutely necessary, of course, but it is dry, and the student is not stimulated and roused to do his best work in accurate drawing or in accurate thinking until he comes to deal with actual things, until he makes actual working drawings which are to be used and not filed away as mere examples of his skill. As a general thing, there is nothing whatever dependent upon the work of a student except mere accuracy as an example of mechanical handiwork or as a basis for criticism by his instructor. I know how this is myself.

For a whole year I struggled with the various problems usually given a young student in drawing, with the result that at the end of that time I could make quite pretty pictures. Then I went into the drafting room of a locomotive shop for the summer vacation. My first job was to make the drawings and blacksmith's sketches of some new-style firebox rings. I succeeded in making these correctly after a time, but I had to get a lot of help from outside sources at odd times, and for a long time it was a wonder to me that I did not lose my place on account of the length of time it took to do that job. But I had my eyes open to the fact that my drawings were to go to the shop to be thumbed and torn by blacksmiths and machinists, and with this incentive ahead of me I made such progress that I graduated from the drafting room into the private office of the head draftsman to work on drawings for the patent office.

The head draftsman of a large shop once told me that he had rather have a young man come into his drawing-room without any technical education, if he had common sense and a steady hand. While there was much truth in what he said, yet he carried the matter to extremes; for while there is too much bookishness and theory and tendency at first to make a drawing a work of art, and not of skill, among the technical graduates, yet it must be admitted that many, very many of them have been well trained mentally and possess the true draftsman's ability to see around a corner and through solid substances. What they lack is not practice in drawing, but intimate acquaintance with cast iron and steel. It cannot reasonably be expected that a young man who draws a crosshead in imitation of another drawing, can do as good or as intelligent work as though he made his drawing from the actual thing and to his own measurements, with the certainity ahead of him that his drawing is to be passed by the head draftsman and used in the shop. When he knows that a single hole drilled in the wrong place may consign an almost completed part to the scrap heap, he will be pretty sure to locate that hole in the right place on his drawing.

The above leads to the conclusion that the work of the school drawing-room is theoretical work only. It is so largely on account of the lack of equipment in the schools in regard to models of actual machines, and the lack of a course in machine shop work where the draftsman makes that which he has already sketched. It arises from the lamentable fact that the average teacher of mechanical drawing has seldom visited an actual machine shop, knows nothing of foundry practice, is not acquainted with the construction, general design or methods of lay-out of such machines as are in actual practical use by mechanics the world over. An occasional visit to a machine shop with a class in drawing is, of course, of great value; but it does not compare at all with the value which an instructor would be to his pupils were he himself intimately acquainted with the methods and process of actual machine design, gained from actual work in a real live drafting room.

The work usually done is from books. Some of these are excellent, some are poor, and very many are worse. The student is worried through perspective and shades and shadows, doing these by rule rather than by common sense. He spends his time on borders and fancy lettering, and he does not become a competent draftsman till he gets out of school.

I do not mean to cry down the schools. I have had their training and am better for it decidedly; but I wasted lots of time there through lack of practical instructions.

J. P.

Providence, R. I.

[With most of what our correspondent writes we are in full sympathy, but we cannot admit that mechanical drawing—considered simply as drawing—is a difficult art. The writer has made some drawings, and, given a mechanical mind to begin with, showing the construction of machines on paper seems to him about the simplest art imaginable; and the number who acquire it, and acquire it well, insensibly, and as a mere matter of association with the work, would seem to demonstrate its simplicity.

The reasons given by our correspondent for the inefficiency of the usual instruction in drawing, are no doubt largely true, and explain why school drawing so often becomes mere picture-making, the resulting "pictures" being neither worth putting in a frame, nor good for anything else. Moreover, we contend that there is no necessity for this, but, on the contrary, that young men can be properly qualified by school instruction to take positions at once as capable and useful assistant draftsmen.—Ed.]

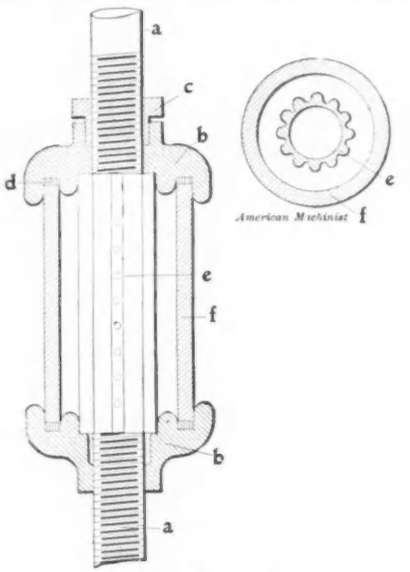
A Novel Water Gage.

Editor American Machinist:

I have often wondered why somebody has not brought out some idea which would do away with the glass gage, as the breakage of the same is a very unpleasant affair. Lately I saw a gage made out of a cast-iron body with a flat glass in front. At the first glance it seemed all right, but in looking the thing over more closely I came to the conclusion that the gage had the great fault, that the water could only be seen from one side, the front, and that the fireman had to step on a certain spot to ascertain the hight of the water in the boiler.

Now, this thing set me thinking, and I constructed a gage which, in my judgment, will fill the bill. A little sketch herewith will show plainly my idea, which I have thought well to cover by an application for a patent, which, as I am assured, will undoubtedly be granted.

As shown in the sketch, *a* is a pipe of metal with the thicker and corrugated part



NOVEL WATER GAGE.

e. A glass tube *f* incloses this corrugated part *e*. The ends of pipe *a* are threaded and cups *b b* are placed on the same; but only the lower cup is threaded, while the tube in the upper cup is large enough to slip over the thread on the pipe, and a nut *c* holds the cup in place and tightens it as required. Small cork washers *d* are placed on the end of the glass tube *f*, and also under the nut *c*, which acts as a stuffing box gland as well as a tightener. In fact, the whole is built very much like a modern oil cup. The corrugated tube *e* is provided with holes to allow the steam and water to circulate in the glass tube. The most remarkable fact is that when the water enters the glass tube it looks as black as ink, so that the water line can be seen at a great distance, inasmuch as the other part of the gage remains bright and light.

The holes in the tube are placed so that they point backward to the wall of the boiler, and in case the glass should break, steam and water will escape in a direction where it can do no damage to the operator. Another advantage is, that the gage can be tightened up at the stuffing boxes as much as desired without fearing breakage, because it is a metal pipe and not glass, yet it can be applied in any place where glass gages are used without any change whatever. The glass tube has walls of ½ inch thickness, and is tested at a steam pressure of 200 pounds, so that a breakage is possible only by a blow. The greatest advantage, however, is the point of cost, which at first is certainly higher than a common gage, but is cheap in comparison when breakages are figured.

Kansas City. C. GASBERG, M. E.

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The Spline for the Tail-Stock Spindle.

Editor American Machinist:

With Tecumseh Swift's objection to the round tail-stock spindle I take issue. In the first place the round spindle is infinitely cheaper to make and to fit into the tail stock. It is much easier to "bore" a round hole than a square one in any device that you may wish to attach to the spindle. The chief fault lies in the method usually adopted by the lathe-builders, which is to drill a hole in the side or bottom of the stock, tap it and screw in a plug, file off the sides and let it go at that.

I defy anyone to think of a method more clumsy or unscientific. The side is the proper place for the spline; either side will do. Drill and ream a hole whose axis will intersect the axis of the spindle. Fit a tool steel plug; mill the two sides, where it will project into the bore; make a nice fit of it in the spline; harden and draw to a dark straw. Make the hole a little larger than the thickness of the wall of spindle housing; make the plug a good driving fit, and drive it in parallel with the spindle. If it don't come right the first time, drive it clear through and try over again.

This method will enable you to go clear to the bottom of the spline, and you will not be "one thread" too deep or shallow, as is usual when the plug is screwed in. This for any ordinary lathe, and for all ordinary purposes, is everything that can be desired. I have an 11-inch lathe fitted this way that has run since 1890, carrying an 8-hole turret on ½-inch tool steel that reduces the stock to about ¼ inch in one cut of one box tool, the other tools being for finishing the work. It has run almost continuously and has made tens of thousands of pieces, and the only appreciable wear is on top of the spindle, at the rear end and at the bottom in front, owing to the weight of the turret, about 20 pounds. The hard surface of the feather, for that practically is what it is, prevents wear to any serious extent, is much stronger than any ordinary method of fastening and is simplicity itself.

Chicago, Ill. H. H. HARDING.

School Draftsmen.

Editor American Machinist:

While reading the articles by Mr. Linch and others, about school draftsmen, one is led to think some of these gentlemen have only guessed at the object of a technical education. If the shop draftsman had taken a technical course, would this additional advantage have been a detriment to him?

The average man entering college is perhaps no smarter than the average man who does not enter college. The average shop man is no draftsman, while all technical graduates are draftsmen.

The technical graduate of ability has a broad education which is seldom acquired by a shop man. Drafting is but one of the branches he has been educated in.

Why compare one whose ability for drafting has led him to surpass all his shop-mates, with the average man who has just issued from college, and is beginning the practical side of life? In a short time the college man of ability becomes familiar with the peculiarities of the shop, which is nearly all the shop draftsman has done, who ordinarily has reached the pinnacle of his career. The technical man is free to surpass in lines the shop man knows nothing of.

When these persons are compared in the relations in which they exist, they are both found to be excellent, but the technical man has by far the longer end of the lever.

R. P. HOWARD.

[Our correspondent's main contention is, of course, sound; but we think there is a good deal of well-founded doubt about all technical graduates being draftsmen, while an examination of the membership list of the American Society of Mechanical Engineers will scarcely sustain the statement that the shop draftsman has ordinarily reached the pinnacle of his career.—Ed.]

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Death of Joseph D. Weeks.

Joseph D. Weeks, editor of the "American Manufacturer," died in Pittsburgh Saturday evening. He was born in Massachusetts fifty-five years ago. He served through the civil war as a hospital minister, and since then had been associated with the iron and steel industries. In the national census of 1880 and 1890 he superintended the gathering of statistics in relation to coke, glass, manganese, petroleum and natural gas, and was regarded as an authority in these and kindred lines.

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Death of Francis W. Holbrook.

Francis W. Holbrook, President of the Union Drop Forge Company, Chicago, died suddenly on the 26th of December, of heart disease. Mr. Holbrook was sixty years old and was widely known as a financial expert.

AMERICAN MACHINIST

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Angus Sinclair, Pres't. John A. Hill, Treas.
C. A. Hansmann, Sec'y.

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Water-Tube Boilers.

We are now hearing much, and in the near future we are doubtless to hear much more, of the water-tube boiler, of its merits and demerits, its advantages and disadvantages, its economy and its wastefulness, the facility or the difficulty of repairs and other particulars concerning it as compared with other types of boilers. Much, if not most, of the matter that will appear will, as in all such cases, be irrelevant and worthless, but in this case probably more so than usual, from the fact that of the water-tube boiler, and of those which it is most distinctly arrayed against, there are, as they say, boilers and boilers.

There are not only good and bad water-tube boilers, with various grades between, as there are also good, indifferent and bad boilers which have no water tubes, but there are also others which combine the principles of the two, with their good or bad qualities as may be.

We may take two entirely different water-tube boilers and another boiler not a water tube, and we find in Kent the following particulars deduced from the results of tests: Comparative weight per I. H. P., 2.02—2.40—0.72; weight per square foot heating surface, 2.10—1.64—0.60; weight per pound water evaporated, 2.50—2.30—0.90; evaporation per cubic foot space, 0.50—0.44—0.95. Here there is quite a difference under each particular between the first and the third figures, but both of those are from water-tube boilers, while the middle figures in each case are from the boiler which has no water tubes.

The comparative practical values of these three different boilers are not determined by the data given above. Many other particulars might be given of these and of still other boilers in which the figures for the water-tube boilers and those of opposing types would be found to mingle and overlap each other, and indicate the hopelessness of being able to show the clear and decisive superiority of one class of boilers over the other. The question of the comparative merits of water-tube boilers must still be based upon the individual type of boiler, and not upon water-tube boilers as a class; and if one such boiler prove superior under certain conditions, it should not warrant the presumption of superiority for every boiler of the class and under other conditions.

The discussion now in progress has to do almost entirely with boilers for marine service. Here, of course, the conditions are very different from those which prevail upon land, and a superiority evidenced by adaptibility to those exacting conditions is certainly not a guarantee for the boiler for universal use.

It is always the new invention which has the most zealous because the most interested advocate, and it is this, therefore, which gets the best showing. The Scotch boiler on the ship and the horizontal tubular boiler on land, which any man is at liberty to build, must look out for themselves. No comparative tests, however, can be of much decisive value which do not in some way get out the best work on both sides.

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Last Year's Legacy.

The record of the year just closed is a brilliant one from a scientific point of view, but it is also from the same standpoint a most peculiar one. The year was one of blossoms rather than of fruitage. It was a year prolific of brilliant promises rather than of full achievement. It showed new fields to conquer, but left the work of occupation still for others.

Early in January, Professor Roentgen announced that by means of a Crookes tube he could photograph bones through the flesh of living bodies, coins through a pocketbook of leather, or pieces of iron in a wooden box. It is not too much to say that the world has not yet found out what commensurate practical use to make of the great discovery.

The year brought us the news that the remaining distance that man must traverse before he stands at the North Pole had been nearly cut in two. With less risk or discomfort than heretofore encountered, Dr. Nansen went nearly two hundred miles nearer the pole than any before him, and left but 225 miles more to conquer. Here also the way was shown for the complete achievement that now seems to be assured, but whether to our profit is questionable.

In photography we are brought distinctly nearer the art of reproducing color as well as light and shade and outline. In medicine we have great promise of increasing ascendancy over disease in the use of anti-toxine.

As we come nearer the field of the mechanic and the engineer, the recent promises are not less brilliant than elsewhere. Electrical knowledge is still rapidly advancing and opening up continually widening possibilities, both in the generation and the application of the mysterious current. Whether the electric motor will yet be independent of the steam engine or the water wheel is becoming a very proper and pertinent question.

The most fascinating of all the problems that man sets for himself is that of rapid movement from place to place. It would often puzzle one to say what great gain there may be in being at any given time elsewhere rather than here, but still we must go, and the means of our going seem to claim more of our thought than any other. The locomotive, and all that it implies, grow constantly, and of late years scarcely ever with noticeable jumps; but in all the other devices for getting the human body over the ground, or over the water, or through the air, the development is a constant wonder. The horseless carriage wants now only a few finishing touches to make it an everyday and universal convenience, and the flying apparatus now needs scarcely more to make man free and ubiquitous as a bird. Our ships still grow in size and in all that gives comfort and safety, the largest of them all being the work of the present year to complete.

The true mechanic instinctively hates above all things to be out of work, and for the assurance of exemption from that experience he may well think kindly of the old year and look with hope on the new. We may say of the old year now gone, and we may say it without reproach, that while both brain and hand were busy and successful, it left at the end more work in sight for the human race than it found ready for it at the beginning. In this we need find no discouragement, but only strength and incentive for successful and profitable activity. If the doing of this year's work also leaves still more in sight—i. e., shows us many other things desirable to accomplish—it will be only as it should be.

When we decided to take up the treatment of electrical matters, specially interesting to our readers, we thought it best, upon the whole, to put such things in a separate department. Some of our reasons for doing this have now, however, disappeared, and the advantage of being at liberty to use as much or as little of electrical matter in any one issue as may seem best, and to put it in any part of the paper that seems best, influences us to discontinue this as a separate department of the paper, and to put in such electrical matter as we have to present, the same as we do matter relating to any other branch of mechanical engineering, choosing the location which at the time seems best or is most convenient.

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Suits which have been pending between the American Graphaphone Company and Thos. A. Edison and the Edison Phonograph Company. are said to have been settled, and that the two companies will act in harmony hereafter.

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Questions and Answers.

Name and address of writer must accompany every question. Questions must pertain to our specialties and be of general interest. We cannot undertake to answer questions by mail.

(1) C. T., Waterbury, Conn., asks: What is the diameter at large and small ends of standard steel mandrels of 1-inch normal size? Are these mandrels left hard, or are they tempered, and if so, to what color? A.—We find such arbors to be tapered usually about .01 inch in 12 inches, and standard size about midway of their length, though sometimes nearer the small end. They are usually made of crucible machinery steel, or a lower grade of tool steel, and are left hard, i. e., the temper is not drawn.

(2) R. W., Louisville, Ky., says: We have until recently used for our motor castings a No. 1 soft pig iron, for which the analysis was as follows:

Silicon	2.89
Sul.	.002
Phos.	.598
Mang.	.605
G. Carb.	2.70
C. C.	.06

We then made a change, using No. 1 soft pig iron from another furnace, whose analysis was:

Silicon	3.34
Phosphorus	.774
Manganese	.693
Sulphur	trace

With the last mixture the speed of our motor was 10 per cent. faster than with the first, using the same winding and armature. Kindly advise us just how the change in mixture affects the speed of our machines, and we would also like you to give us the analysis of a good mixture for electric motors. A.—The speeding-up of the motor would indicate a weaker field due to iron of less magnetic permeability. There is very little exact knowledge in print regarding the effect of impurities on the magnetic properties of iron—such information being carefully guarded by its possessors. In this state of affairs it is not possible to give an exact analysis, but in general the softer the iron the better, and the effects of impurities, especially silicon and manganese, are unfavorable. It will be seen that with the two analyses submitted, lower permeability goes with the high silicon and manganese, and, in point of fact, we should say these elements were too high for good results in both cases. The most that can be said is that the iron should be soft, should contain as little silicon, manganese and phosphorus as possible, and should be periodically tested by electrical methods, rather than by chemical analysis, as the knowledge of the effects of the latter is, as stated, too limited for definite conclusions, and, moreover, the history and treatment of the iron has a marked influence in addition to the composition.

(3) W. F. F., Warren, Mass., asks: What would be the pressure on the cut-off valve of a Meyer gear in the two positions shown in the sketch? A claims that in Fig. 1 the load would be nothing more than the weight of the valves, and that in Fig. 2 the load would be that due to the area of the port times the steam pressure plus the weight of the valves. B claims that there is a constant pressure due to the area of the two plates multiplied by the steam pressure, no matter what the position. A.—We are not aware that the question as relates to Fig. 1 can be positively answered. Two planed plates in the open air have a friction between them due to their weight only, but two scraped surface plates show greater friction due, as usually supposed, to the pressure of the air, but thought by some to be due to the true force of cohesion brought into play by the close contact. If the valves are in a condition approximating surface plates, and if the action of surface plates is due to atmospheric pressure, the valves under steam pressure would, of course, develop a friction depending on the pressure; but if the action of surface plates is due to cohesion, there should be no increase when put under steam pressure. We understand that experiments made in England have shown that surface plates act precisely the same in a vacuum as in the open air, which would indicate that their action is due to cohesion, and would lead

Fig. 1

Fig. 2

us to expect that their friction would not be increased under steam pressure. Regarding Fig. 2, we can speak more positively. Professor Robinson made some experiments on this subject some years ago, and demonstrated that the pressure forcing a plate to its seat, under the conditions of the left-hand valve of Fig. 2, was larger than that due to the port area, but smaller than that due to the valve area. His explanation was that there is a creeping of the steam along the joint, which partially neutralizes the pressure on the top of the plate. This steam, he considered, entered the joint at full pressure, and gradually fell in pressure to nothing at the leaving edge of the joint. The experiments were made with a circular plate, 6 inches diameter, representing the valve, and having a cavity 2.1 inches in the center, communicating with the external air and representing the port. His pressures ranged between 5 and 75 pounds by gage, and he found the resultant pressure on the back of the plate to be equivalent to full pressure on a circle 2.6 inches diameter for 5 pounds gage pressure, which circle ranged upward to 3.7 inches diameter for 75 pounds gage pressure. The natural conclusion from these experiments is that if there were no cavity in the plate, and no communication with the air, the creeping steam would establish the same pressure under as over the valve, and that the friction of the plate, or of the valves shown in Fig. 1, would be the same, regardless of the pressure on them. In this conclusion, Professor Robinson's experiments point in the same direction as the English experiments already referred to. It will be seen that the action is obscure and not fully understood.

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Business Specials.

Transient Advertisements 40 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Gear wheels, gear cutting. Grant; see page 16.

Pat'n cast'gs a spec'lty. H. D. Phelps, Ansonia, Ct.

Forming Lathes. Mer. Mach. Tool Co., Meriden, Ct.

Milling Machs. Kempsmith Co., Milwaukee, Wis.

Ideal Twist Drill Grinder. T. Hall, 853 B'way, N.Y.

Engine Castings ⅛ to 2 H. P. Finished boilers and engines. Grant Sipp, Paterson, N. J.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N.Y.

Duplex and special gear cutters, counterbores, cutter and surface grinders, vertical millers, hand punches and shears. R. M. Clough, New Haven, Ct.

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British Frankness Again—American Cycle-Making Tools.

We have had occasion recently to comment on the spirit of frankness which characterizes the British mechanical press in comparing the products of their own and other countries, and we have pleasure in presenting the following abstract of an article which appeared in "Engineering" for December 18th, under the title "American Machine Tools." The article is an editorial brought out by the exhibit of the Pratt & Whitney Company, at the recent National Cycle Show, and is of interest both as an illustration of this spirit of frankness and as an indication of the position attained by American manufacturers in the production of cycle-making tools:

"It is not a reassuring thing, for those who would see the engineering supremacy of this country maintained, to notice how certain American firms have ranged ahead of us in the production of a light class of machine tools, of which bicycle-making machines afford an example. At the present time, with the demand for bicycles still great, and new factories being started constantly, manufacturers have the greatest difficulty in obtaining the special plant they require. It is easy enough to purchase ordinary lathes, milling machines, power drills, etc., but with these the bicycle maker cannot hope to produce his wares at anything like the same speed or at so low a cost as can those who are fortunate in possessing the special labor-saving and extremely accurate tools such as those we describe on another page.

No doubt a good many ingenious cycle-making tools have been constructed in this country, but these have been largely designed by the cycle makers themselves—when they happen to have been mechanics also—and have not been put upon the market. Under these circumstances the American makers have stepped in, and are, at the present time, reaping a rich harvest in selling, pretty well at their own prices, special cycle-making machinery of a nature which cannot be purchased from British manufacturers.

"The fact is the more annoying because there is nothing in these tools which our native mechanics could not have produced if they had only thought—but then, thinking is the hardest work a mechanic does. We recognize the ingenuity of these American machines, the skillful way in which they are devised to get over difficulties and to produce mechanically the maximum result—both in quantity and quality—with the least amount of costly human intervention. The candid Englishman must admire these things, but he is apt to attribute them wholly to the natural mechanical genius of the American—something native to the soil, which he summarizes as 'Yankee ingenuity.' Now, if in anything genius may be rightly described as 'an infinite capacity for taking pains,' it certainly is so in regard to mechanical design. All these beautiful devices we see in the Pratt & Whitney machines did not flash into the brains of their originators during idle moments, like lightning in a summer sky; but, however suddenly the end may have come, they were the results of previous study of what was required, and careful thought as to the best way of producing it. And if this is true of the individual, it is equally so of the corporation or firm to which he belongs. We had in this country some years ago a man who grasped the importance of extreme accuracy in mechanical work, and, having recognized a need, he thought no pains wasted which enabled him to reach his end. It would be untrue to say there are none of the same stamp in England now, but if we could believe that the spirits of the dead walk the earth, we should look to find the ghost of Whitworth in a machine tool shop of New England.

"It is hard to account for this higher perfection of light machine tool making on the other side of the Atlantic. We are apt to consider that in a new country things are inclined to be hap-hazard and makeshift, but we must not forget that the engineering history of New England extends almost as far back as that of Old England. At any rate the first American designers had all the benefit of our early experience; for come what may, nothing can rob England of the honor of being the birthplace and nursery of modern mechanical engineering. Perhaps we have been a little spoiled by our past success.

"The earlier British engineers perfected the standard machine tools, and the engineering industry of the country has been so great that makers have not been forced into what are known as 'special lines.' When the heads of firms find they can make a good income by selling the same thing over and over again, they do not seek for fresh combinations; unless, indeed, they have a natural love for designing. It may be that it is here the New Englander has now the most considerable advantage. In the past many of our own machine tool makers were men who were brought up in the shops; mechanics, made into business men and heads of firms by the force of circumstances, but still mechanics. They had mastered their craft in the school of necessity, and loved it for its association with early days, and as a means by which they reached prosperity. They sent their sons to expensive schools where the spirit of mechanical ingenuity has been an unknown thing; classics and the politer branches of learning being considered all-important. When the young man entered upon his business career he would be put in the shops; a strange world where his previous training gave him no insight into what should be done. He found the work of design and execution in the hands of those who were destined soon to be his subordinates. In the press of business it had grown to be looked upon as inferior work, relegated to the draughtsman and foreman. He would remain in the shops long enough to get a 'fair knowledge of the work,' and then pass to the office to take what was thought to be his proper position in directing the commercial and financial policy of the establishment.

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"In the United States we have somewhat different conditions. Our remarks apply chiefly to the New England States, but we believe the same conditions prevail in most parts of the Union. The early machine tool-makers, like our own, were men who had a thorough workshop training; that is, they worked for their living, and did not simply 'pass through the shops.' The New England mechanic is, however, a different man to his *confrere* in this country. Whatever may be said about 'there being no more equality in a republic than under a monarchy,' and of the 'aristocracy of the almighty dollar,' or of 'class distinctions being as strongly marked in America as in England,' there is no doubt that the New England mechanic holds himself more the equal of his employer than does the English craftsman; and, further, that the employer recognizes this claim. The fact has nothing to do with the form of government; in our opinion the root of this healthy feeling is in the method of education, under which the sons of masters and men, or if the terms be preferred, of employers and employed, sit on the same form at school. The influence is good for all; it levels up both classes. It widens the sympathies of one, whilst it refines the other. How much America owes to this healthy commingling of the classes in early youth it is difficult to say; but there can be no doubt that in the past it has been a most potent factor in the production of a race of native-born Americans—upon which we Englishmen may look with pride as our near relatives—a race which has enabled a new country to assimilate the vast crowds of aliens that have flocked to its shores from all parts of the world.

"In regard to the engineering industry, and the machine-tool trade in particular, the results have been most fortunate. The sons of employers have entered upon their career with a truer appreciation of the work of the artisan, and the value of shop practice, on which the success of the business must, after all, so largely depend. On the other hand, the young artisan sees that his employers are not a race apart, but have characteristics in common with himself, so that it only needs a change of environment to enable him to take his place among them.

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"It is not, as we have intimated, so much by mechanical genius as by foresight and enterprise—the two qualities generally go hand in hand—that the Americans have achieved their success in light machine-tools, more particularly in labor-saving appliances for special industries, such as the sewing machine, the watchmaking and the typewriter trades; we would add the small arms industry, but we remember that here English tool makers have achieved notable triumphs in the past. There are plenty of mechanics in Great Britain who, if definite ends were set before them, would solve the problems of construction involved in producing automatic machines equal to those which are now coming in such numbers across the Atlantic. But with us there is the obstacle that the brain to direct and the brain to do so seldom come together. We know one eminent engineer in Great Britain who attributes much of the remarkable success that has attended his career to unrestricted council with those he employs, and, we may add, he has always given an ungrudging recognition of their services; but it requires a clear vision and more than ordinary strength of mind to see the wisdom of such a course and to follow it up in a country where the after-influence of a feudal system is not altogether extinct, seldom as the fact is recognized.

* * * * * *

"At present we occupy far away the premier position in the manufacture of heavier machine tools. For instance, the chief marine engineering shops and shipyards of the world are fitted with British-made plants, or, at least, close copies of our designs. There is no good reason why we should throw up the sponge in the contest for smaller tool orders."

American-Built Vessels for Japan's Navy.

The Japanese Government has contracted with the Cramps and with the Union Iron Works for two vessels for the Japanese Navy, one to be built in each place, and to cost about $1,500,000. It is reported that these contracts were given after a very thorough examination of what is done by the various establishments of the world, and that, in the judgment of the Japanese naval authorities, they are getting better vessels for their money than could be had elsewhere.

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Commercial Review.

NEW YORK, SATURDAY EVENING, JAN. 2.

We are, at the present writing, already launched out upon the year 1897, and 1896 with its attendant features of business demoralization is entirely a matter of history. It goes without saying that, for the last fortnight or so, most lines of business have been given over to holiday influences. As a general thing, the annual period through which we have been passing is not conducive to activity in heavy hardware; but in the present case the iron market followed the example of the dry goods stores by opening a bargain counter, on which steel billets were offered at a great slaughter of price, even $15.50 per ton being accepted, and heavy buying resulted.

The Bessemer Steel Association (billet pool) is still sufficiently alive to hold a meeting next Monday afternoon, and it is stated that a special committee appointed to consider its future policy will recommend a prolonged existence by means of a system in which the larger mills will buy up the allotment of the smaller fry and pay them for doing nothing.

In a few days, at most—assuming Washington advices to be infrequent—trade will be free to improve, if it should elect so to do. Events, or lack of events, subsequent to the election have demonstrated its innate sluggishness, and it is morally certain to "go slow," but if it goes at all, that will be something to be grateful for, and there is now no adequate excuse for its not doing so.

The Pennsylvania Railroad Company has placed various contracts for steel rails to the amount of 40,000 tons; the Western New York & Pennsylvania will soon order about 2,000 tons, and in the spring the Lehigh Valley about 10,000 tons.

REPORTS ON THE ENGINE MARKET.

Here are a few letters from engine and boiler builders, as to their outlook. They are presumably as favorable as the average, to say the least, for we find this class of people rather reticent about putting their reflections on paper.

The Edward P. Allis Company, Milwaukee, Wis., write:

"In reference to the business outlook, would say that we are employing the average number of men, and are receiving, from time to time, about the usual run of orders. In fact, during the depressed period of the last two or three years we have been fortunate enough to have kept our entire force employed."

From the Rice & Sargent Engine Company, Providence, R. I.:

"Our engine business is quiet; but we are receiving more inquiries now, and there is quite a movement for the larger railway and electric light engines. We expect to see an improving market this winter and spring."

From the Erie City Iron Works, Erie, Pa.:

"While the volume of trade for the past year has not been all we could hope it to be, yet, on the whole, it has been quite satisfactory, and the prospects for next year, we think, are very bright. Inquiry is coming in very heavy, and for large plants, from thoroughly first-class concerns. There seems to be a desire on the part of users of steam power to re-equip their plants and put in the most modern and complete steam plants, so that, for the coming year, we look for a very large and lucrative trade. We believe, from the inquiries we have received, and from the prospect ahead, that the steam user throughout the United States has been educated to an idea of economy in operation, rather than low-priced first cost, and the consequence is that most of the inquiry is for high-grade goods. This we consider as being one of the most healthful conditions that possibly can exist."

From the Weston Engine Company, Painted Post, N. Y., who seem to be exceptionally busy:

"We observe the following facts in regard to our business and the outlook for the coming year: First, That there is plenty of business; people are requiring more light and more power, and that means more engines. It also means that other lines of business must be picking up, to cause the increased demand for light and power. Second, This prosperity seems to be on the increase, because orders are multiplying, and that, in many instances, without solicitation. There seems to be a forward step along all industrial lines, and the pace is being quickened day by day. Third, These conditions are not limited to any one section of country; the distribution of trade and orders seems to be about equally divided between the East, West, North and South, as in our experience the trade is not local in any sense. Fourth, Collections are close, but becoming easier with the better state of things everywhere, which naturally must follow, from the very nature of affairs. We close the old year and begin the new, running twenty-four hours each day, with a double force of workmen."

That engine builders in Germany have been faring better than those in this country is implied in the statement that the Krupp works ordered some triple-expansion engines from a large concern in Goerlitz, and have been reported, after an interval of fourteen months, not yet to have received them. Either the demand must be very heavy, or this particular manufacturer is uncommonly popular, or he is an exceeding slow workman.

The Joseph Dixon Crucible Company, Jersey City, N. J., have issued a circular concerning their business condition, the gist of which is, that while they have felt the dullness of 1896 to be somewhat greater than that of 1895, they have managed to hold their own pretty well by means of confidence and energy and think that the future offers encouragement to those who are likewise disposed.

THE REVIVAL OF THE EXPORT TRADE

is, so far as can be judged from this close perspective, and setting political questions aside, the one bright spot on the market of 1896 by which it can be memorialized. Since the time, a few months ago, when we began to call the attention of our readers more especially to this matter, the volume of exports has continued to increase, and public interest in it has risen.

The following are among recent export shipments: By the Frick Company, Waynesboro, Pa., to Johannesburg, an ice plant comprising eleven car-loads and having a capacity of 30 tons per day. By the Ramapo Wheel & Foundry Company, of Ramapo, N. Y., to the Paulista Railroad, Brazil, 80 pairs of Snow's boltless steel-tired wheels on steel axles, with 120 loose tires and 120 loose axles. Through L. P. Rose & Co., shippers, to Guatemala, C. A., an invoice of electrical machinery and materials claimed to be one of the largest ever sent there from this country. An electrical and power plant, which we believe to be one mentioned in these columns when the order was received, and costing, when the entire plant is set up, about $150,000, is just starting for the cities of Jalapa and Coatepec, with two neighboring towns, in Mexico. The West Coast Iron Bridge Company, San Francisco, has contracted to ship several iron bridge structures to the government of San Salvador.

A COMMERCIAL PORTFOLIO IN THE UNITED STATES CABINET,

with a removal of the consular service from the Department of State, is the subject of a bill now pending in the Senate. It is strongly supported by the National Association of Manufacturers, two prominent members of whose Executive Committee are Ex-Mayor of Brooklyn Chas. A. Schieren, who is a large manufacturer of leather belting, and Mr. Chas. A. Moore, of the machine-tool firm of Manning, Maxwell & Moore. Some extracts from a press interview with Mr. Moore, which state the policy advocated by the association, may be interesting to "Machinist" readers: "There is little doubt that South America is soon going to be a great

(Continued on page 39.)

Help Wanted.

Situation and Help Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. The Cash and Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

TO SUBSCRIBERS

whose names appear on our subscription list, this paper will give two free insertions under this heading to those in want of positions. The advertisement to occupy a space of not more than five lines. Additional space or insertions must be paid for in advance at regular rates.

All round machinist and tool maker wants position. Box 220, AMERICAN MACHINIST.

Tool maker, first-class, used to drawings, wants position. Box 221, AMERICAN MACHINIST.

Wanted—First-class toolmaker, accustomed to light work. Address Box 12, AM. MACHINIST.

Machine dr'ghtsm'n wants situation; long experience, good ability; mod. salary. Box 10, AM. MACH.

Wanted—Pos. as designer of spec. mach; tech. edu., prac. mechanic; dev'pm't of exp. work with Mfg. Co. preferred. Box 11, AM. MACHINIST.

Draughtsman wants position; technical graduate; experienced in designing steam pumps and automatic machinery. Box 4, AM. MACHINIST.

Mech. draughtsman, exp. in shop and drawing room, general and power transmitt'g mach., neat and accurate, wants pos. Box 9, AM. MACHINIST.

A first-class tool die maker and draftsman wants a change; 15 yrs.' exp.; interchangeability of parts a specialty; investigat on courted. Box 219, AM. MACH.

Wanted—A mechanical d'ftsman (practical) who has had some experience on printing presses. State ref., age and wages expected. Box 223, AM. MACH.

A practical toolmaker and designer, with a thorough technical education and several years' experience desires a western position as superintendent. Address Box 8, AM. MACHINIST.

Wanted by a thorough, practical mechanic, die sinker, and tool maker, position as ass't sup't or foreman; good manager of help; now in charge; best of reference. Box 13, AM. MACHINIST.

First-class draftsman wanted. Experienced in designing modern machine tools and special automatic m'ch'ry. One who understands German pref' state experience and ref. Box 14, AM. MACHINIST.

Milling machine foreman is open for engagement; used to Brown & Sharpe Universal and all kinds of milling on machine tool work; gear cutting; can make tools for machines; best of references. Box 225, AMERICAN MACHINIST.

Draughtsman and mechanical engineer exp. in power transmission, cable traction, oil gas furnaces, marine, dredging, hoisting and conveying machinery, timber constr., etc., wishes pos. New York or vicinity; A 1 ref. Box 5, AM. MACH.

To an enterprising machine or engine builder an excellent opportunity is offered to secure control of the latest manifestation in steam engineering; thoroughly covered by several patents developed past experiment and highest efficiencies assured. For general outlines see issue in hand; for further particulars address L. Hollingsworth, Jr., Scotch Plains, N. J.

A 1 expert and thorough mechanic on gas and gasoline engines, at present holding responsible position with large concern manuf'g gas engs., wishes to change; will accept pos. as manager or as general traveling salesman and expert with a firm that appreciates ability and inventive genius developing gas engines to highest efficiency, and electric lighting with same, a specialty. Box 1, AM. MACH.

▲ ▲ ▲

Miscellaneous Wants.

Advertisements will be inserted under this head at 30 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Cheap 2d h'd lathes & planers. S.M. York, Clev'd, O.

Calipers & Gauges. F. A. Welles, Milwaukee, Wis.

Wanted—Carbonized wire for chain rivets. Box 217, AMERICAN MACHINIST.

All kinds of engines and machinery built to order. New Jersey Machine Works, Newark, N. J.

Best and cheapest Bolt Header, made by Baush & Harris Machine Tool Co., Springfield, Mass.

Light and fine mach'y to order; models and electrical work specialty. E O. Chase, Newark, N. J.

Wanted—Partner with $10,000 to take interest in establ'd machine screw business. Box 2, AM. MACH.

Special mach'y for manuf. of bicycle chains. Full particulars. Garrard, Ryland st., Birmingham, Eng.

For Sale—Second-hand drill presses, engine lathes & planers. Dietz, Schumacher & Boye, Cincinnati, O.

We make a specialty of Shartle's patent safety set collars. Prices low and samples free. Middletown Machine Co., Middletown, Ohio.

Wanted—New or second hand, in good condition, 5 to 6 ft. turning mill; also Universal milling machine and other milling machinery. Address Box 3, AMERICAN MACHINIST.

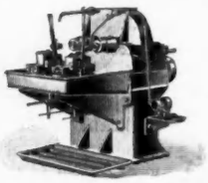
We offer an exceedingly fine lot of first-class second-hand machinery, lathes, planers, shapers, drills, millers, screw machines, etc. Call, or get list 17 B. The Garvin Mach. Co., 440 Canal st. N.Y.

Wanted—An Idea. Who can think of some simple thing to patent? Protect your ideas; they may bring you wealth. Write John Wedderburn & Co., Patent Attorneys, Washington, D. C., for their $1,800 prize offered to inventors.

Columbia University
in the City of New York.

SCHOOL OF MINES,
SCHOOL OF CHEMISTRY,
SCHOOL OF ENGINEERING,
SCHOOL OF ARCHITECTURE,
SCHOOL OF PURE SCIENCE.

Four years' undergraduate courses and special facilities for graduate work in all departments. Circulars forwarded on application to the Secretary of the University.

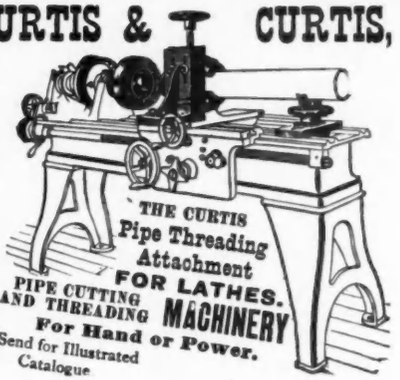


Automatic Solid Die Bolt
THREADING MACHINES.
Two Styles. Four Sizes.
Send for Catalogue "A."
Webster & Perks Tool Co.
Cor. Spring and Monroe Sts.,
Springfield, Ohio.

Machine Shop Wanted.

Correspondence is desired with owner of above, by capable parties, with a view to operating same. Best references furnished as to ability. Address, **J. C., care American Machinist, New York.**

CURTIS & CURTIS,
66 Garden St., Bridgeport, Ct.



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PATENTED.

Balls cannot wear in grooves.
Hardened surfaces ground true.
Balls specially gauged to uniform size.
Load equally distributed over all the balls.

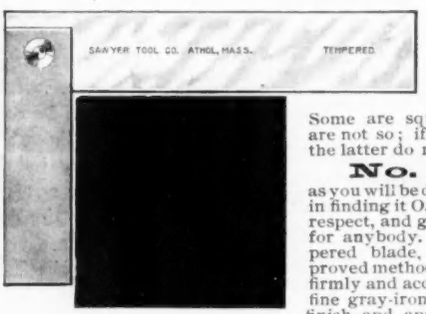
HUB ROLLER BEARINGS.

Short Rolls accurately guided in parallel lines.
Rolls properly hardened, tempered and ground.

We furnish these Anti-friction Bearings for all shaft sizes.

THE BALL BEARING CO.,
10 WATSON ST., BOSTON.

SPEAKING OF
SQUARES



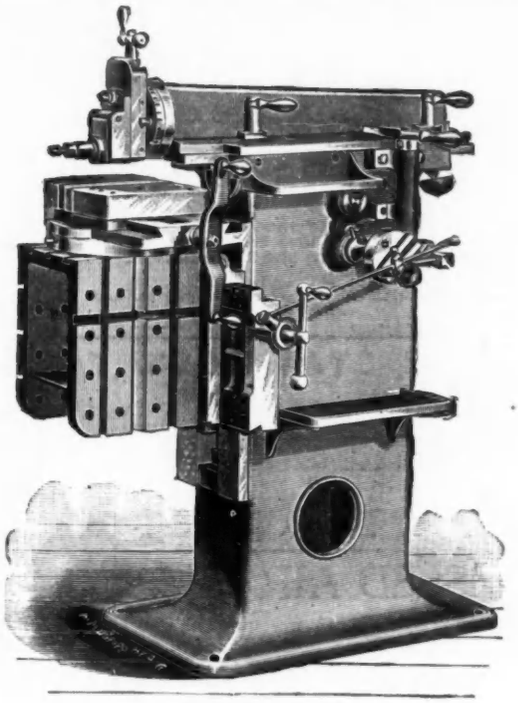
Some are square, many are not so; if you desire the latter do not buy our
No. 41,
as you will be disappointed in finding it O. K in every respect, and good enough for anybody. The tempered blade, by an improved method, is secured firmly and accurately in a fine gray-iron stock. Its finish and appearance is excelled by none, and you can be sure of getting the best value for your money.

▪ ▪ ▪

SPECIAL OFFER: To introduce them we will send them prepaid until April first, sizes and prices as follows:

4-inch	6-inch	8-inch	10-inch	12-inch
$1.50	$2.25	$2.75	$3.50	$4.50

Sawyer Tool Co., Athol, Mass.



.. IMPROVED ..

15-inch Hendey Shaper.

Latest Improvements.
Useful Attachments.
Strong and Powerful.

...FOR...

Die Work, Tool Room or General Shop Work.

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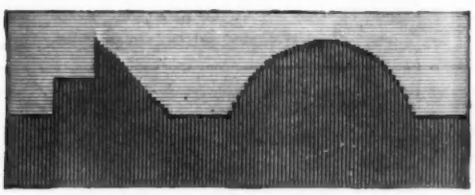
The stroke can be adjusted for curves with machine in motion. The stroke can be adjusted for angles with machine in motion. The stroke can be adjusted for irregular work with machine in motion. It has adjustable table for planing taper work; table can be removed for fastening work to apron. Has a strong graduated swivel vise. Quick work, rapid changes, modern ideas.



This cut shows how stroke can be adjusted with machine in motion by micrometer; adjustment fine and delicate. SEND FOR CIRCULAR.

▲ ▲ ▲ ▲

THE HENDEY MACHINE CO.

TORRINGTON, CONN.

Agents for the Pacific Coast—PACIFIC TOOL AND SUPPLY COMPANY, San Francisco, Cal.

European Agents, { **CHAS. CHURCHILL & CO., London and Birmingham.**
SCHUCHARDT & SCHÜTTE, Berlin and Vienna.
EUGEN SOLLER, Basel, Switzerland.

(Continued from page 37.)

field for American manufacturers. We ought to control the markets there absolutely, and we probably will before another twenty-five years. . . . The project involves the special training and careful selection of young, active, hard-working and competent Americans for consular work down there. . . . It involves a great expansion of our merchant marine, possibly the subsidizing of mail-carrying steamers to ports not now touched by American steamers, and a vigorous policy on the part of the United States to protect the interest of American manufacturers in their efforts to achieve commercial supremacy in South America."

Quotations.

NEW YORK, Monday, January 4th.

Iron—American pig, tidewater delivery:

No. 1 foundry, Northern	$12 00 @ $13 00
No. 2 foundry, Northern	11 75 @ 12 00
No. 2 plain, Northern	11 25 @ 11 50
Gray Forge	10 75 @ 11 50
No. 1 foundry, Southern	11 50 @ 12 00
No. 2 foundry, Southern	11 00 @ 11 25
No. 3 foundry, Southern	10 50 @ 11 00
No. 1 soft, Southern	11 00 @ 11 50
No. 2 soft, Southern	10 50 @ 11 00
Foundry forge, or No. 4 Southern	10 25 @ 11 00

Bar Iron—Base—Mill price, in carloads, on dock; common, 1.10 @ 1.15c.; refined, 1.20 @ 1.50c. Store prices: common, 1.40 @ 1.50c.: refined, 1.50 @ 1.80c.

Tool Steel—Ordinary sizes, standard quality, 6 @ 7c., with some brands perhaps a little less; extra grades, 11 @ 12c.; special grades, 16c. and upward.

Machinery Steel—Ordinary brands, from store, 1.65c.

Cold Rolled Steel Shafting—Base size in carloads, about 2¼c.; 2¾c. for smaller quantities from store.

Copper—Carload lots, Lake Superior ingot, 11⅝ @ 11¾c; electrolytic, 11¼ @ 11⅝c.; casting copper, 11⅛c.

Pig Tin—For 5 and 10-ton lots, 13.05c., f.o.b.

Pig Lead—In carload lots, 3.65c., f. o. b.

Spelter—In carload lots, New York delivery, 4.05c., f. o. b. and upward.

Antimony—Cookson's, 7¼c.; Hallett's, 6¾ @ 6¾c.

Lard Oil—Prime city, present make, commercial quality, in wholesale lots, 40 @ 42c.

▲ ▲ ▲

Manufactures.

Mr. W. W. Cherry, Ashton, Ont., is having a machine shop erected.

The Lutz Co., of Trainer, Pa., expect to erect a new oil works at an early date.

The Atlantic Refining Co., Philadelphia, Pa., will erect a new factory at Point Breeze.

The National Iron and Wire Co., of Cleveland, Ohio, intend to place new machinery.

Stein Bros., Warren, Ohio, will soon put in new machinery for the manufacture of ice.

The Merrow Machine Co., Hartford, Conn., will build a new factory on Laurel street, that city.

At San Francisco, Cal., A. Christie will soon begin the erection of a machine shop on Fremont street.

Blumenhagen & Epding, Chicago, Ill., are to erect a new factory and also a new engine house, 35 x 50 feet.

The East Rockford Mach. Co., Rockford, Ill., has been formed. Incorporators, O. B. Harding and O. Bergquist.

The Berkshire Mills Co., Bridgeport, Conn., are to make an addition to their plant. New machinery will be installed.

At Emporia, Va., Peart, Neilds & McCormick are erecting a new factory, which will be equipped with new machinery.

Front Street Engine Works, Toronto, Ont., has recently been destroyed by fire. The property is owned by John Perkins.

Dr. J. J. Detwiler, of Easton, Pa., and a number of other capitalists are arranging to build a cement factory at Coplay, Lehigh Co.

At Madison, Wis., the Two Rivers Iron Works

has been formed. Incorporators, Conrad Werra, H. K. Appelman and C. E. Mueller.

At Denver, Colo., the Meyers Pneumatic Pump Co. has been formed. S. S. Groves, John S. Logan and Wm. M. Meyers are interested.

At Columbus, O., the Columbus Gas Engine Co. has been formed. John Kelcher, Wm. A. Pope, Lawrence J. Hickey are interested.

Almeron Hayes and Hiram Casey, South Manchester, Conn., it is reported will engage in the manufacture of car wheel grinders.

At Stockton, Cal., there are prospects of J. W. Kelly, of San Francisco, building a new factory for the manufacture of starch, chlorides, etc.

At Louisville, Ky., the Union Cement and Lime Co. has been formed. Messrs. W. A. Robinson, J. W. E. Bailey, and J. I. Cooper are interested.

At Denver, Colo., the Colorado Mining & Electric Machinery Co. has been formed. Directors, W. H. Perkins, Leona H. Jenkins and Leon H. Jenkins.

Shoenberger's mill at Pittsburg, Pa., was recently destroyed by fire and the loss on machinery will reach about $50,000. The shop will be rebuilt.

The Pacific Coast Chemical Co. has been formed at Oakland, Cal., for the manufacture of chemicals. E. V. Wacheter, Albin Meyer, and Chas. Alaine are interested.

The old factory of the Morewood Tin Plate Co., Elizabeth, N. J., will be reopened in the spring, and machinery for the manufacture of copper wire will be installed.

At Belt, Mont., the Stucco Works, in which Messrs. W. M. Cockrill, F. H. Smith and M. H. Luther are interested, will place new machinery and start up in the spring.

The Northwestern Match Company, of Spokane, Wash., has been incorporated. The trustees are Lorenzo D. Farmin, Alfred J. Harris, Charles Rudolph Zienke and A. K. S. Fulton.

The Missouri Malleable Iron Co., East St. Louis, will make a large addition to their capacity by increasing their plant of annealing furnaces. They will use the Taggart pattern of furnace.

The Hipwell Manufacturing Company, of Allegheny, Pa., has decided to erect on North avenue a fine four-story buff brick factory containing much improved machinery of the latest type.

The foundations for the Damon Safe & Iron Company's new buildings at East Cambridge, Mass., have been completed and work commenced on the elevation. The main shop in the rear, of steel construction, having one story, will be 85 x 160 feet.

Wolff & Zwicker Iron Works has been formed at Portland, Ore. Object, to acquire and carry on iron works, machine shops, boiler works, shipyards, factories, etc; principal office and place of business, Portland; capital, $100,000; incorporators, F. Wolff, J. C. Wolff, and A. Zwicker.

▲ ▲ ▲

New Catalogs.

There are three sizes of Standard Catalogs, first authorized by the Master Car Builders' Association, 9" x 12", 6" x 9" and 3½" x 6". We recommend the 6" x 9" size for machinery catalogs. When they must be larger or smaller, one of the other standard sizes should be adopted if possible.

We have received from the Joseph Dixon Crucible Company, Jersey City, N. J., a catalog describing and illustrating various kinds of graphite, lubricants, paints, blacklead crucibles, etc. It is standard size, 6 x 9.

The Garvin Machine Company, New York, N. Y., have sent us a catalog devoted to the illustration of machinery used in the manufacture of bicycles, including spoke drilling machines, cup truing machines, hub drilling machines, etc. It is 5 x 6¾ inches.

The Waterbury Farrel Foundry & Machine Co., Waterbury, Conn., send us pamphlets Nos. 1, 2 and 4, the first describing and illustrating rolling mill machinery, the second tube and wire mill machinery, and the fourth hardware machinery. They are all 5¼ x 6½ inches.

The Pratt & Whitney Co. HARTFORD, CONN., U.S.A.

...MAKERS OF...

Fine Machine Tools.

Complete Plants furnished for Bicycle, Typewriter, Gun and Sewing Machine Makers. Gauges and Small Tools for all Machine Work. Drop Hammers and Trimming Presses. Forging and Trimming Dies for all classes of work.

England—BUCK & HICKMAN, 280 Whitechapel Road, London, E.
France—FENWICK FRERES & CO., 21 Rue Martel, Paris.
Germany and Austria—SCHUCHARDT & SCHUTTE, Berlin and Vienna.
Chicago—42 and 44 South Clinton St. *Boston*—281 Franklin St. *New York*—123 Liberty St.

FINE STAY-BOLT TAPS.

WILEY & RUSSELL MFG. CO., GREENFIELD, MASS., U. S. A.
Agents in London, SELIG, SONNENTHAL & CO., 85 Queen Victoria Street.

COMPRESSED AIR

Practical Information upon Air-Compression and the Transmission and Application of Compressed Air, by Frank Richards, Mem. A.S.M.E. 12mo, cloth, $1.50.

JOHN WILEY & SONS, 53 East 10th St., New York City.

CATALOGUE FREE.

4 POINTS!!!! Design! Workmanship! Material! Finish!

All these are comprised in the make-up of our lathes and are the four necessary points in the construction of a good tool. Add to these a FIFTH and a very important one, the price, which we make very low to prompt cash buyers, and you have the story. Our Catalogue will tell you all about our Lathes, Planers, Shapers, etc.

SEBASTIAN LATHE COMPANY,
117 and 119 Culvert Street, CINCINNATI, OHIO, U.S.A.

DYER & DRISCOLL,
PATENT SOLICITORS, 36 WALL ST., N.Y.

Have done all my patent soliciting work, both for this and foreign countries, continously for the past fourteen years.

Thomas A. Edison

STAR LATHES

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Foot Power Screw Cutting, Automatic Cross Feed, 9 and 12" Swing.

Send for Catalog B.

Seneca Falls Mfg. Co.
697 Water St., Seneca Falls, N.Y.

'96 THE NEW '96 JENKINS '96

IS the Perfection of Joint Packing. Instantaneous, **Does Not Squeeze Out** and not necessary to follow up joint. We guarantee it to last for years on any and all pressures of steam or any kind of joint where packing is required. Does not rot, burn or blow out, therefore the best for all purposes. Call for and insist on having '96 JENKINS '96, stamped like cut. . . . . .

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NORTON EMERY WHEEL CO.

WORCESTER, MASS.

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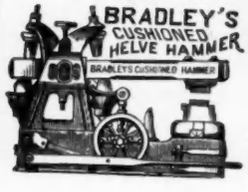

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Syracuse, N. Y.

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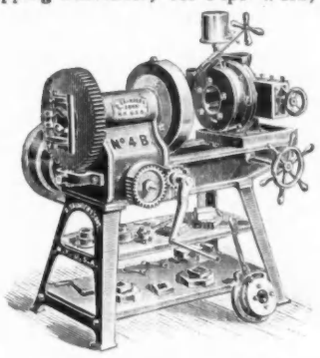
MANUFACTURERS OF

Pipe Cutting and Threading Machines

Steam and Gas Fitters' Hand Tools, Tapping Machinery for Pipe Work, etc.



The No. 4 B. Machine for Cutting and Threading Pipe ½ to 4 in., by HAND or POWER.

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The best Bicycle Brazing Solder is the "Ball's Wire Spelter" made by Montgomery of N. Y. It is not the cheapest. The best '97 wheels will use it. Get samples, make up your mind and place your orders early.

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Machinists' Fine Tools
STANDARD TOOL CO., ATHOL, MASS.
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Albro Worm AND Worm Gear

Consumes less power and gives better results than any other system. Proofs cheerfully furnished.

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Grant Calculating Machine Co., Boston, Mass.

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Ingersoll-Sergeant Drill Co., New York.
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ASBESTOS CEMENT FELTING.
Johns Mfg. Co., H. W., New York.

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Cleveland Machine Screw Co., Cleveland, O.

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Ball Bearing Co., The, Boston, Mass.
Hyatt Roller Bearing Co., Newark, N. J.
Mossberg & Granville Mfg. Co., Providence, R. I.

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Schultz Belting Co., St. Louis, Mo.

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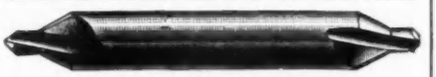

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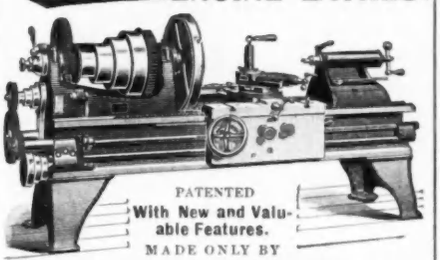

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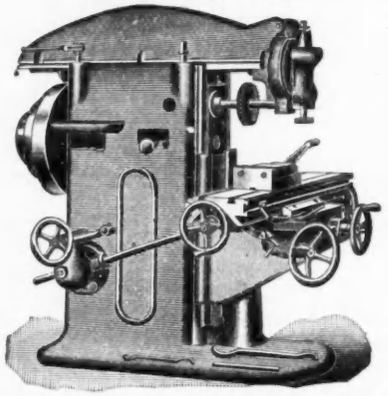

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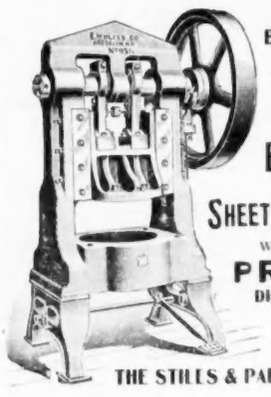

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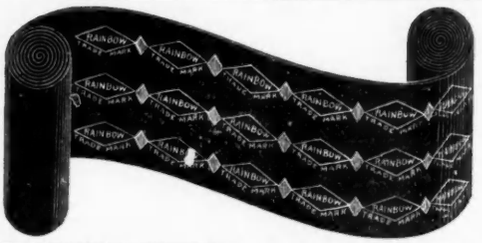

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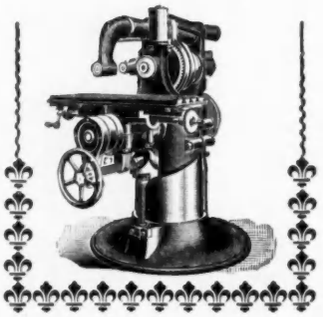

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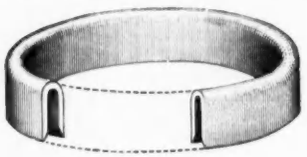

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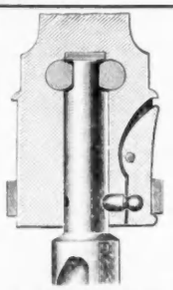

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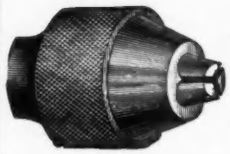

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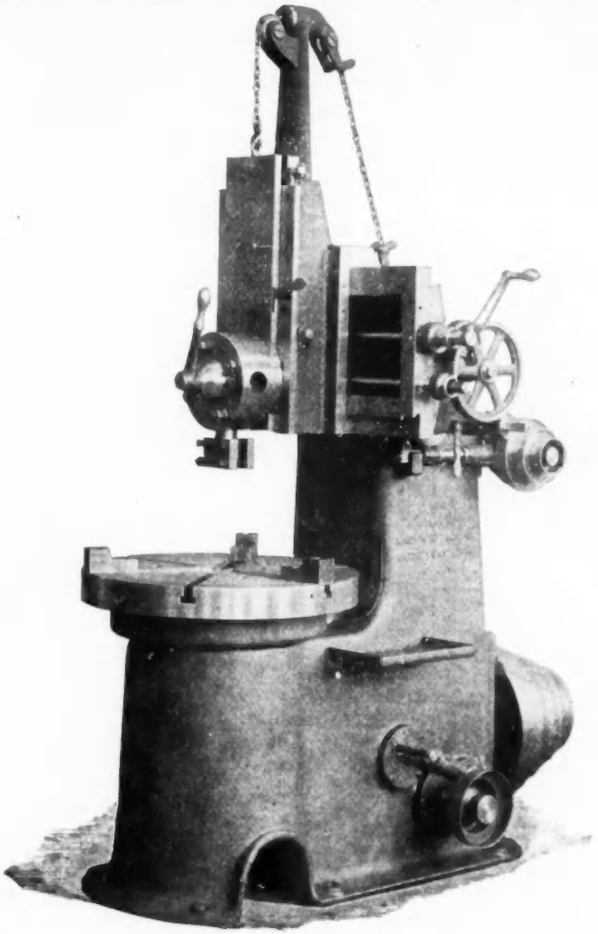

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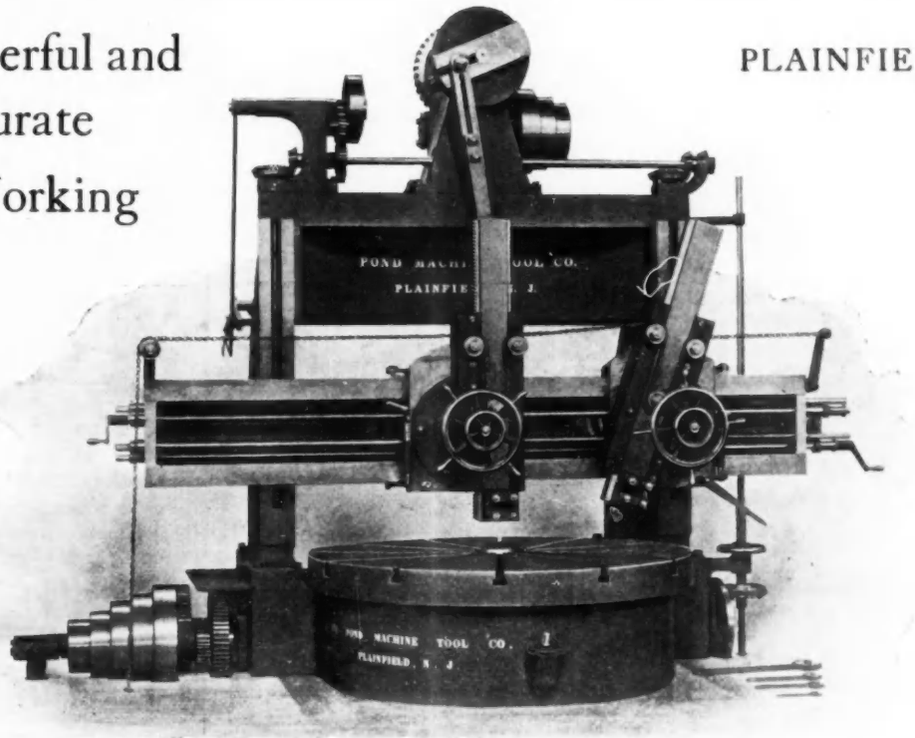

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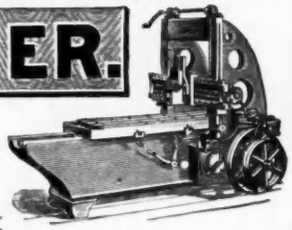

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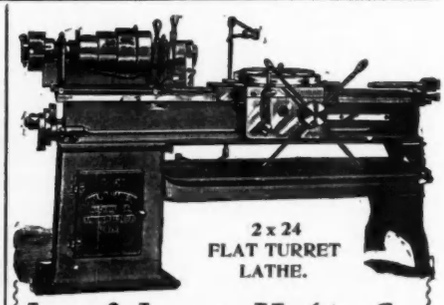

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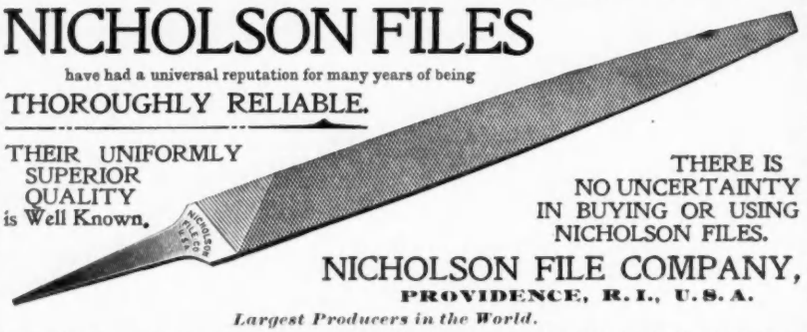

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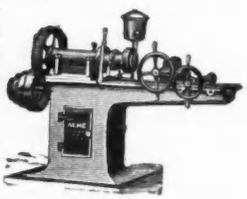

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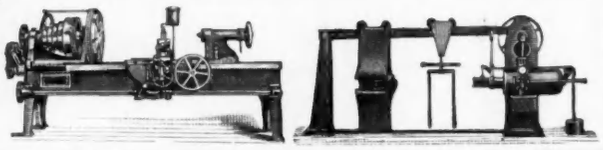

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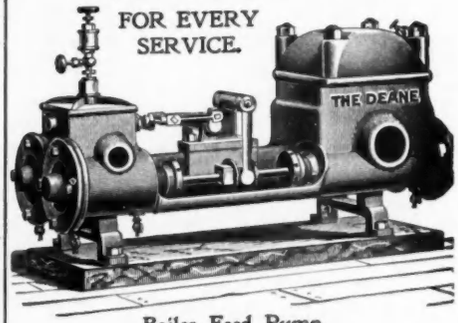

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